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Volume 5 Number 20 / October 23, 1967

TABLE OF CONTENTS

Subject Categories

Abstracts in the journal are grouped under the following categories:

page:

01 AERODYNAMICS
Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion. **3559**

02 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **3564**

03 AUXILIARY SYSTEMS
Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. **3568**

04 BIOSCIENCES
Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. **3570**

05 BIOTECHNOLOGY
Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences. **3580**

06 CHEMISTRY
Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. **3587**

07 COMMUNICATIONS
Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **3599**

08 COMPUTERS
Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics. **3605**

09 ELECTRONIC EQUIPMENT
Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. 3609

10 ELECTRONICS
Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. 3613

11 FACILITIES, RESEARCH AND SUPPORT
Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. 3618

12 FLUID MECHANICS
Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. 3622

13 GEOPHYSICS
Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. 3626

14 INSTRUMENTATION AND PHOTOGRAPHY
Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. 3637

15 MACHINE ELEMENTS AND PROCESSES
Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, reliability; drafting; and materials fabrication, handling, and inspection. 3645

16 MASERS
Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State. 3653

17 MATERIALS, METALLIC
Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see : 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics. 3654

18 MATERIALS, NONMETALLIC
Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. 3662

19 MATHEMATICS
Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers. 3668

20 METEOROLOGY
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. 3672

21 NAVIGATION
Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. 3676

22 NUCLEAR ENGINEERING
Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems. 3677

23 PHYSICS, GENERAL
Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation. 3686

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR
Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation. 3690

25 PHYSICS, PLASMA
Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems. 3705

26 PHYSICS, SOLID-STATE
Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics. 3711

27 PROPELLANTS
Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems. 3715

28 PROPULSION SYSTEMS
Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants. 3716

29 SPACE RADIATION
Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear. 3719

30 SPACE SCIENCES
Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. 3723

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. **3730**

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. **3735**

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. **3743**

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents. **3749**

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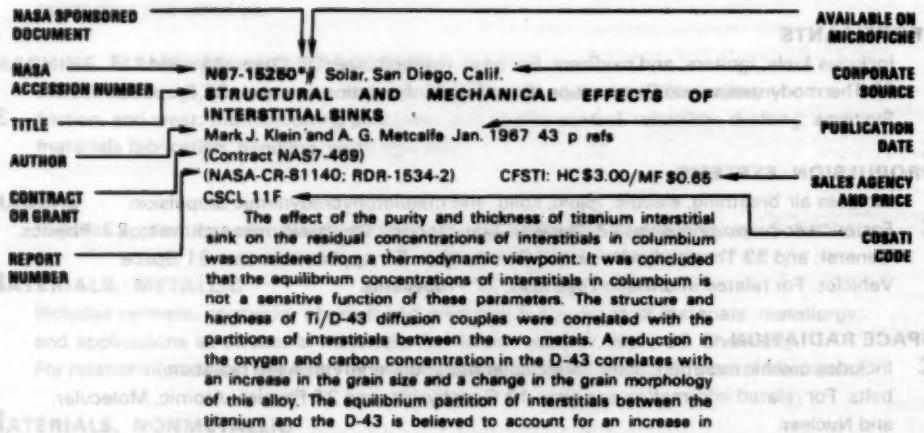
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STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
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Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs
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The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43. Author

VOLUME 5, NUMBER 20 / OCTOBER 23, 1967

Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

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N67-34070 General Electric Co., Philadelphia, Pa. Missiles and Space Div.

INVISCID STREAMLINES ON YAWED SPHERE-CONES—THE PRESSURE-METHOD APPROXIMATION

Bruce B. Ross 30 Nov. 1966 35 p refs

(MEMO-66-18)

The pressure approximation method, based on Runge–Kutta numerical integration, was applied to the conical surface of a yawed sphere-cone to derive theoretical streamline cone paths. Constant, modified Newtonian, and sine-variation pressure distributions were used in generating these paths. The theoretical paths were than compared with each other and with data from two experimental sphere cones tested under hypersonic flow conditions using oil rings to determine streamline paths very near to the cone surface. Including steepest descent method data, results show that in the regions outside of the shaded region the order of increasing steepness for the theoretical streamline paths were: constant pressure, steepest descent, sine-variation, and modified Newtonian. Additionally, all three sets of pressure method paths tended to cross the leeward meridian of the cone, supporting the expected conclusion that the present analysis breaks down on the leeward side of the cone, particularly at high angle of attack. None of the four streamline methods produced paths which were steep enough to match the experimental oil streak paths. E.C.

N67-34099# Royal Aircraft Establishment, Farnborough (England).

ON THE NON-LINEAR THEORY OF WINGS OF SMALL ASPECT RATIO [K NELINEINOI TEORII KRYL'EV MALYKH UDLINENII]

S. D. Ermolenko Mar. 1967 22 p refs Transl. into ENGLISH from Aviatsionnaya Tekhnika (USSR), v. 2, 1966 p 9–18

(RAE-LIB-TRANS-1218) CFSTI: HC $3.00/MF $0.65

A method is described for calculating the lift, induced drag, and pitching moment of flat rectangular wings of low aspect ratio in subsonic flow. The wing is divided into panels by lines perpendicular to the mainstream. A bound vortex is introduced on the quarter-chord-line of each panel. Each bound vortex is built up into a horse-shoe vortex by adding two straight, free, vortices, which lie vertically above the side edges at an inclination to the free stream which is to be found. The strengths of the horse-shoe vortices are determined by satisfying the wing boundary condition, in the mean, on the three-quarter-chord-line of each panel. The inclinations of the free vortices are found by requiring them to lie parallel to the component of the overall velocity which lies in the vertical plane. The inclinations must be determined interatively, but for aspect ratios near one, they are near to one-third of the incidence. Compressibility is introduced through an affine transformation. Using two panels, close agreement with experiment is found for A = 1, 2, and 5 at M = 0 and for A = 1 at M = 0.5, 0.7, and 0.9. Author

N67-34199# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.

SOME PRELIMINARY EXPERIMENTS ON PROBE INTERFERENCE IN HYPERSONIC NEAR WAKES

Pasquale M. Sforza May 1967 24 p ref

(Contract Nonr-839(38); ARPA Order 529)

(PIBAL-1011; AD-653875) CFSTI: HC $3.00/MF $0.65

Preliminary results concerning the effects of probing the recirculation region of a slender cone in hypersonic flow with conventional diagnostic techniques are presented. Experiments were performed at a free stream Mach number of 11.8 and unit Reynolds number of 600,000 per foot on a 5 degree half-angle cone with a base diameter of 10 in. The centerline axis of the recirculation region was investigated with various probes extended from the base (probe diameters were roughly one-hundredth of the base diameter) while base pressure at the base centerline and centerline pitot pressure at a station in the supersonic near wake were monitored. Similar studies were made while monitoring only the stagnation temperature profile in the supersonic near wake. It was found, for the above experimental conditions at least, that probes placed along the axis distorted downstream pitot pressures while off-axis curved probes did not appreciably alter either base pressure or downstream pitot pressure. In addition, it was found that extending even the off-axis probe too far from the base into the recirculation region (into the vicinity of the rear stagnation point) greatly disturbs the stagnation temperature profile at a station in the supersonic near wake. Author (TAB)

N67-34249# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).

APPLICATION OF BLUNT TRAILING EDGE BLADINGS TO SUPERSONIC COMPRESSOR STAGES Final Scientific Report, 30 Apr. 1966–1 May 1967

Jacques Chauvin and Frans Breugelmans May 1967 73 p refs *Its* Note Interne No. 22

(Grant AF-EOAR-65-65)

(ARL-67-0120; AD-653595) CFSTI: HC $3.00/MF $0.65

A review is given of cascade, rotor and stage tests made on blunt trailing edge blades in the high subsonic, the transonic

and the supersonic regimes. For what concerns cascade tests, satisfactory high subsonic operation was obtained with turning of the order of 55 degrees. The positive effect of back pressure on the losses was ascertained, as well as the possibility of reducing secondary flow effects by using slots. (Reduction of 50% of the losses at mid-span). The rotor tests on a second generation design showed significant improvement on the first model. A peak total pressure ratio of 2.8 with an adiabatic efficiency close to 85% was reached. The stage tests were made to investigate rotor–stator interference, stagger effect and effect of slotting. An optimum rotor–stator distance and stagger are found. The positive effect of slotting the stator blades is confirmed. Author (TAB)

N67-34339 National Physical Lab., Teddington (England). Aerodynamics Div.
CALIBRATION OF THE FLOW IN AN NPL 36 INCHES × 14 INCHES
W. J. Graham, A. G. J. MacDonald, and J. A. Soulsby Jul. 1966 38 p refs
(NPL-AERO-1043)

A liner static-pressure orifice lying 3.6 chords upstream of a biconvex aerofoil at zero incidence has been found to be unaffected by the model's flow field. The "reference Mach number", given by the pressure at this point, has been correlated with the "tunnel Mach number", measured at the model location, for a wide range of liner open-areas. The differences between these two Mach numbers are found to be small when the liner slots are fully open, but become more significant for smaller open areas. Author

N67-34342 Royal Aircraft Establishment, Farnborough (England).
MEASUREMENTS OF SECTION LIFT COEFFICIENT IN A TWO-DIMENSIONAL SMOKE WIND-TUNNEL
Masao Yamana Mar. 1967 17 p refs Transl. into ENGLISH from J. Japan Soc. Aeron. Eng. (Japan), v. 13, 1965 p 321–328
(RAE-LIB-TRANS-1220)

An investigation was made in a two-dimensional smoke wind tunnel to determine the lift coefficient of a wing section by observing the shape of a specified streamline. The wind tunnel was of a horizontal type, and fine variations could be made to the vertical positions of the streamlines, so that the specified streamline passed through a fixed point, at a given station, upstream of the model. The ordinates of the streamline were measured at two further stations downstream of the first, and the sectional lift coefficient, and the position of the center of pressure, could then be determined. The method offers a convenient means of understanding how the flow pattern relates to the sectional lift coefficient. Author

N67-34389 Royal Aircraft Establishment, Farnborough (England).
FLIGHT MEASUREMENTS OF PRESSURE FLUCTUATIONS IN A TURBULENT SUBSONIC BOUNDARY LAYER AND THE RELATION WITH WALL SHEAR STRESS
K. H. Heron and D. R. B. Webb Oct. 1966 35 p refs
(RAE-TR-66338)

The measurements were taken in order to augment the rather scant information that exists at low Strouhal numbers. The results confirm existing data as regards spectrum and the relation of the integrated pressure levels with kinetic pressure and wall shear stress. The relationship between the pressure levels and wall shear stress is of particular interest in applying the data to supersonic speeds. Author

N67-34408 National Physical Lab., Teddington (England). Aerodynamics Div.
BRIEF DETAILS OF THE EXPERIMENTAL FACILITIES OF THE AERODYNAMICS DIVISION, NPL (AUGUST 1966)
R. C. Pankhurst and L. Pennelegion Sep. 1966 16 p refs Supersedes NPL-AERO-1081
(NPL-AERO-1205; NPL-AERO-1081)

Tables of data for 1) equipment used for investigating incompressible flow, 2) for high speed wind tunnels, 3) for hypersonic tunnels, and 4) for shock tube facilities, are presented. The shock tube facilities are used for research on high temperature gas physics. L.S.

N67-34566 Gt. Brit. Ministry of Aviation, London. Aeronautical Research Council.
INVESTIGATION OF THE NORMAL FORCE CHARACTERISTICS OF SLENDER DELTA WINGS WITH VARIOUS RHOMBIC CROSS-SECTIONS IN SUBSONIC CONICAL FLOW
D. L. I. Kirkpatrick HMSO, 1967 54 p refs Supersedes RAE-TR-65291; ARC-27990; see N67-26143
(ARC-CP-922; RAE-TR-65291; ARC-27990) HMSO: 10s 6d

This report describes an experimental technique which was developed to determine the aerodynamic normal forces associated with the conical flow fields round slender wings at incidence. With this experimental technique it is possible to obtain the accurate information necessary for the investigation of the theoretical similarity of the conical flow fields round slender wings with different cross-sectional shapes. The report presents the results of the tests on four low-aspect-ratio wings with rhombic cross-sections whose leading-edge angles were $\pi/6$, $\pi/3$, $\pi/2$ and $2\pi/3$. These results show that the development with incidence of the normal force is appreciably affected by the magnitude of the leading-edge angle. The normal force component associated with the leading-edge vortices, which are characteristic of the flow round slender wings, develops much more slowly with incidence when the edge angle is large than when it is small. As the leading-edge angle is reduced, the slope of the normal force characteristic at zero incidence increases in the manner predicted by slender body theory, though the measured values are slightly smaller than those predicted. Author

N67-34612# Advisory Group for Aerospace Research and Development, Paris (France).
SUBSONIC WIND TUNNEL WALL CORRECTIONS
H. C. Garner, ed. (Natl. Phys. Lab., Teddington, Engl.), E. W. E. Rogers, W. E. A. Acum, and E. C. Maskell Oct. 1966 476 p refs
(AGARDograph-109) CFSTI: HC$3.00/MF$0.65

Developments in the formulation, calculation, and application of interference corrections are detailed for subsonic wind tunnel walls. A general review of interference effects is presented; and numerical data, principal formulas, and experimental results are detailed for lift interference on two-dimensional and three-dimensional wings; as well as for interference effects in unsteady experiments, blockage effects in closed or open tunnels, wall interference in tunnels with ventilated walls, and bluff bodies and high lift systems. M.W.R.

N67-34626 National Physical Lab., Teddington (England). Aerodynamics Div.
FREE-FLIGHT TESTS IN THE NPL 6-IN. (15-CM) SHOCK TUNNEL OF MODEL HB-2 USING MULTIPLE SPARK RECORDING
L. Pennelegion, P. F. Cash and M. J. Shilling 19 Oct. 1966 29 p refs
(NPL-AERO-1212; ARC-28415) CFSTI: HC$3.00

Free-flight measurements of axial force, normal force and pitching moment of an HB-2 model have been made in a 6-in. shock tunnel and the results compared with force balance data obtained elsewhere. The displacement of the polyurethane models was recorded as a set of overlapping images on one photographic plate. Author

N67-34692# Aeronautic Research Council (Gt. Brit.)
EXPERIMENTS AT MACH NUMBER=4.03 ON TWO FAMILIES OF PRESSURE-PLOTTING WING-AND-HALF-CONE COMBINATIONS
G. W. E. Rogers, J. L. Attridge, A. G. J. MacDonald and J. Callinan 1967 47 p refs Supersedes NPL-AERO-1094; ARC-25695; see X65-12351
(ARC-R&M-3473; NPL-AERO-094; ARC-25695) CFSTI: HC $3.00/MF $0.65

Tests have been made on eight models, two isolated delta wings of 75° and 80 sweepback, and six wing-body combinations having underslung cones of up to 13° semi-vertex angle. Surface pressure distributions were measured and analysed to show how the wing and body flow fields interact. Subsequently the lift and pressure drag of all models were estimated to illustrate how the overall forces and lift/drag ratio were modified by increasing body size. Author

N67-34712 Gr. Brit. Ministry of Aviation, London. Aeronautical Research Council
LOW SPEED WIND TUNNEL TESTS ON A SERIES OF RECTANGULAR WINGS OF VARYING ASPECT RATIO AND AEROFOIL SECTION
G. G. Brebner, L. A. Wyatt, and Gladys P. Ilott HMSO, 1967 131 p refs Supersedes RAE-TR-65236; ARC-27889; see X66-18640
(ARC-CP-916; RAE-TR-65236; ARC-27889) HMSO: 1£ 3s

To provide experimental evidence on the loading and pressure distribution of low aspect ratio wings and on the variation of aerofoil section characteristics with aspect ratio, wind tunnel tests were done on a series of rectangular wings with aspect ratios varying from 4.0 to 0.5 and three different aerofoil sections. Two of the sections were cambered and all had the RAE 101 thickness distribution, t/c=0.10. The tests comprised balance measurements of lift, drag, and pitching moment, pressure measurements at the centre section (which have been integrated to obtain local forces and moments) and boundary layer transition observations. A limited analysis has been done of the local and total forces and moments, comparisons being made with the methods of Küchemann and Weber for calculating load and pressure distribution. The experimental pressure distributions offer scope for considerably more analysis. Author

N67-34724# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
LAMINAR COMPRESSIBLE BOUNDARY LAYER ON A YAWED INFINITE WING
K. Kaups and G. Kaltner 15 Mar. 1967 74 p refs
(LB-32706)

The exact first order compressible, laminar boundary layer equations for a yawed infinite cylinder are solved for air with enthalpy and pressure dependent fluid properties. The method of solution is based on that given by Smith and Clutter, with the derivatives normal to the leading edge replaced by their finite difference equivalents and the equations transformed by the Illingsworth-Levy transformation. The resulting ordinary differential equations are solved by direct integration. An iterative procedure between the momentum equations, the energy equation, and the fluid properties is necessary. The method was programmed on the IBM 7094 computer, under the program number 19R3, to handle flows with arbitrary pressure gradient, wall temperature or heat transfer, and blowing or suction. For the case of surface radiation, the heat transfer rate to the surface is specified, and surface temperature and heat transfer rate to the air are calculated by solving the energy equation with nonlinear boundary conditions. Temperature and density are expressed in terms of local enthalpy and pressure in the range of equilibrium dissociation. Calculations with Lewis number different from one use the concept of effective Prandtl number. Comparisons are made with existing similar solutions for the yawed stagnation line, and the effects of fluid properties on profiles are shown. The method was also applied to a section of a slab delta wing at a high angle of attack. Here the agreement between measured and calculated heat transfer rates was found to be better on the upper surface than on the lower surface. Author

N67-34735 Royal Aircraft Establishment, Farnborough (England).
THE EFFECT OF BASE BLEED ON THE BASE PRESSURE OF SEVERAL SHROUDED AND UNSHROUDED PROPELLING NOZZLES AT M∞=1.96
M. M. Shaw Jun. 1966 84 p refs
(RAF-TR-66182)

Based pressure measurements have been made on a bluff area surrounding a propulsive jet with and without base bleed. The effects of altering the jet Mach number and the ratio of jet exit area to total base area have been indicated. The tests were extended to measuring base pressure inside a shroud, and a correlation between the unshrouded and shrouded results is obtained. The results from the shrouded tests are compared with those from simple one-dimensional theories, with some success. Calculations of thrust efficiency show that high values can be obtained with the right combination of nozzle design Mach number, bleed flow and jet to maximum area ratio. If air of low total head, e.g. from an intake bleed, has to be disposed of, then feeding it into a duct surrounding a shrouded jet nozzle can be an efficient means of disposal. Author

N67-34883*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A WIND-TUNNEL INVESTIGATION OF A 7-FOOT-DIAMETER DUCTED PROPELLER
Kenneth W. Mort and Berl Gamse Washington, NASA, Aug. 1967 42 p refs
(NASA-TN-D-4142) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Power, free-stream velocity, blade angle, and duct angle of attack were varied to define the aerodynamic characteristics of a full-scale ducted propeller. Dynamic pressure ranged from 0 to 106 psf, rotational velocity from 1200 to 2590 rpm, blade angle from 14° to 49°, and power from 0 to 1250 hp. The results indicate that the ducted propeller achieved a maximum figure of merit of 81 percent and a maximum propulsive efficiency of 74 percent. Stall boundaries for both the upstream and downstream duct lips were based on pressure distributions. It was found that for a representative V/STOL configuration employing this ducted fan the upstream lip could stall at low power and at high duct angles; however, stall of the downstream lip did not appear to be likely. Author

N67-34904# College of Aeronautics, Cranfield (England).
STABILITY OF GROUND EFFECT WINGS: A PRELIMINARY SURVEY OF THEORETICAL AND EXPERIMENTAL TECHNIQUES
P. E. Kumar May 1967 25 p refs
(COA-AERO-196)

A survey of existing experimental and theoretical work associated with wings in ground effect has indicated a lack of information concerning the unsteady, or quasi-steady, aspects of the problem. Some of the problems encountered in the stability and control of a ground effect wing are considered, and attempts are made at obtaining some feel for the longitudinal and lateral stability derivatives. An outline of possible future theoretical work is given, as are some preliminary quasi-steady wind tunnel results. Author

N67-34931 National Physical Lab., Teddington (England). Aerodynamics Div.

A TURNING-VANE PARAPET FOR THE IMPROVEMENT OF FLOW OVER A HELICOPTER LANDING DECK

D. W. Bryer Sep. 1966 17 p

(NPL-AERO-1209)

Brief smoke-visualisation tests, on a 1/192 scale model of the complete scheme as then envisaged and on a 1/96 scale model of the principal building only, showed that, for certain ranges of wind direction, large-scale vortices would occur over the deck. When the wind direction was within approximately ±10 degree from the normal to the windward edge, flow separation over the deck appeared to give a marked discontinuity in wind speed at a height equivalent to about 30 ft full-scale; below this height, a low-velocity turbulent region was observed. Tests with the 1/192 scale model showed that the conditions were alleviated when buildings of similar height to the deck were on its windward side. The observations suggested that large-scale vortices would be unlikely. In order to suppress the large-scale vortices from the front and end edges, whilst at the same time preserving the outline of the original solid parapet, an array of turning vanes was fitted to the 1/96 scale model. This scheme, although crudely executed at the time, was found to be effective. Author

N67-34969# Gt. Brit. Ministry of Aviation, London. Aeronautical Research Council

EXPERIMENTS CONCERNING THE EFFECT OF TRAILING-EDGE THICKNESS ON BLADE LOSS AND TURBINE STAGE EFFICIENCY

I. H. Johnson, D. C. Dransfield, and D. J. Fullbrook HMSO, 1967 22 p refs Supersedes NGTE-R-264; ARC-26625; see X65-12973

(ARC-R&M-3459; NGTE-R-264; ARC-26625) CFSTI: HC $3.00/MF $0.65

Theoretical assessments of the influence of trailing edge thickness on turbine blade loss coefficients are reviewed and compared with the results of a cascade tunnel investigation. Tests on a single-stage turbine indicate that efficiency is much more sensitive to stator blade trailing edge thickness than simple estimates would indicate, but rotor blade thickness effects on efficiency are in line with simple prediction. Author

N67-34994*# Boeing Co., Renton, Wash. Commerical Airplane Div.

ANALYSIS AND DESIGN OF SUPERSONIC WING-BODY COMBINATION, INCLUDING FLOW PROPERTIES IN THE NEAR FIELD. PART II: DIGITAL COMPUTER PROGRAM DESCRIPTION

E. La Rowe and J. E. Love Aug. 1967 820 p

(Contract NAS2-3719)

(NASA-CR-73107; D6-15044-2, Pt. II) CSCL 01A

The digital computer program developed to analyze and design wing-body combinations at supersonic speeds is described. The geometry sections redefine the body as an equivalent body of circular cross section. The wing and that part of the body in the region aft of the wing leading-edge intersection are subdivided into a large number of panels. The wing may be defined to have thickness or may consist of a camber surface only. The aerodynamics section then solves the problem by first computing the velocity components induced by the various singularities that represent the configuration. The body thickness and camber effects are represented by line sources and doublets along the body axis, and wing thickness effects are represented by a distribution of sources located in the wing reference plane. The effects of camber and incidence of the wing and effects of any residual interreferences are simulated by a surface distribution of vortices on the wing and body. When the velocity components are computed, the program determines the strengths of the singularities required to satisfy the given boundary conditions. The program also solves the direct analysis problem of calculating pressures, forces, and moments on a given configuration, and the indirect design problem of determining the wing shape for a given lift distribution. The program selects the boundary conditions appropriate to the particular optimization, direct or indirect problem being considered, and solves the problem. The flow visualization section computes velocities at selected field points and integrates streamlines about the configuration. Author

N67-34997*# Boeing Co., Renton, Wash. Commercial Airplane Div.

ANALYSIS AND DESIGN OF SUPERSONIC WING-BODY COMBINATIONS, INCLUDING FLOW PROPERTIES IN THE NEAR FIELD. PART I: THEORY AND APPLICATION

F. A. Woodward, E. N. Tinoco, and J. W. Larsen Aug. 1967 301 p refs

(Contract NAS2-3719)

(NASA-CR-73106; D6-15044-1, Pt. I) CSCL 01A

A numerical method for the analysis of wing-body combinations and the flow fields around them, and for the design of optimum wing camber surfaces in the presence of a body is presented. The method is based on the linearized theory of supersonic flow. The wing and body are represented by a large number of singularities located in the plane of the wing, on the surface of the body, and along the body axis. The velocity components induced by these singularities at selected control points define a matrix of aerodynamic influence coefficients. The aerodynamic matrix is used to calculate the pressure distribution on the wing and body for given boundary conditions, or to determine the wing camber surface corresponding to a given aerodynamic loading. Additional operations may be performed on the matrix to determine the wing camber surface required to minimize the drag of the wing-body combination under given constraints of lift and pitching moment. Once the strengths of the singularities are known, flow field velocities may be calculated from which streamlines and flow directions can be determined. Application of the method has shown good correlation with both theory and experiment. In particular, detailed pressure and force comparisons were made on a wind-tunnel model tested at Mach 1.8. The program also was used to predict the drag reduction achievable through optimizing the wing camber surface on this model. Author

N67-35011*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

AERODYNAMIC EFFECTS OF BULBOUS BASES

Lars Eric Ericsson Jun. 1967 63 p refs

(Contract NAS1-6450)

(NASA-CR-66434; LMSC-4-17-67-3) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An exploratory study has been made of the effect that a bulbous base can have on the aerodynamic characteristics of blunt space capsules and slender reentry bodies. It is found that the base has a profound effect and can cause drastic loss of dynamic stability. A careful examination of available experimental data reveals that the often complex effects of bulbous bases can be explained using quasi-steady separated flow concepts. In general, a bulbous base adversely affects the vehicle dynamics but increases the static stability. Sting interference is a serious problem because it is capable of preventing a dynamic test from revealing that the full-scale vehicle is dymamically unstable. A possible means of measuring and correcting for this dynamic sting interference is outlined. Author

N67-35028 National Physical Lab., Teddington (England). Aerodynamics Div.

AERODYNAMIC FORCES AND YAWING MOMENTS ON A WATER-LINE MODEL OF S. S. ST. FINBARR

C. F. Cowdrey Apr. 1966 15 p
(NPL-AERO-1193)

Results are given of measurements of the aerodynamic forces and yawing moments on a model of the White Fish Authority's trawler S.S. St. Finbarr for the full range of relative wind direction. Comparison is made between the results obtained in a uniform wind stream and in an artificially produced boundary layer similar in profile to that normally encountered near the earth's surface. The results of measurements made at two wind speeds, approximately 45 and 90 ft/sec (26 and 52 knots) showed little effect due to change of aerodynamic scale. Author

N67-35069 Societe pour l'Etude et la Realisation d'Engins Balistiques, Courbevoie (France).
CALCULATION OF LOADS DUE TO GUSTS [CALCUL DES CHARGES DUES AUX RAFALES]
J. B. Kerisel 4 Oct. 1966 29 p refs In FRENCH; ENGLISH summary Presented at 23d AGARD Congr. on Struct. and Mater.

A review is first made of the various aspects involved in the application of the technique of generalized harmonic analysis to gust loads on missile in rough air. The characteristics of the atmospheric turbulence velocity field are described. The technique of calculations of responses (transient response especially) in rough air is then presented with some applications to French missiles. Author

N67-35113*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FORCE MEASUREMENTS ON AXISYMMETRIC MODELS WITH HAMMERHEAD NOSES AT TRANSONIC SPEEDS
Bruno J. Gambucci and Robert C. Robinson Washington, NASA, Aug. 1967 19 p refs
(NASA-TM-X-1433) CFSTI: HC $3.00/MF $0.65 CSCL 01A

A wind-tunnel investigation was conducted to determine normal-force, pitching-moment, and axial-force coefficients for five models with hammerhead noses. Data were obtained for model angles of attack from approximately −1° to +4° and a Mach number range from 0.70 to 1.20. Reynolds number, based on model base diameter, varied with Mach number from 1.81 to 2.19 million. Author

N67-35128 Royal Aircraft Establishment, Farnborough (England).
EXPERIMENTAL INVESTIGATION OF THE GROUND EFFECT ON THE SUBSONIC LONGITUDINAL CHARACTERISTICS OF A DELTA WING OF ASPECT RATIO 1.616
D. L. I. Kirkpatrick Jun. 1966 44 p refs
(RAE-TR-66179)

The experiment described was made to investigate the effect of ground proximity on the subsonic longitudinal characteristics of a thin delta wing whose aspect ratio was 1.616. In order to provide a sufficiently comprehensive set of data to show how the ground effect on the wing varied with its incidence and height, the characteristics of the wing were measured with it mounted at seven different distances above a thin ground board fixed in a wind-tunnel. It was found that, as the wing's height was reduced while its incidence was kept constant, the slope of its lift characteristic and its static stability both increased considerably and its induced drag factor decreased. The increase in the slope of the wing's lift characteristic at zero incidence was found to be inversely proportional to its height. Author

N67-35170 Royal Aircraft Establishment, Farnborough (England).
THE FLOW FIELD NEAR THE CENTRE OF A ROLLED-UP VORTEX SHEET
K. W. Mangler and J. Weber Oct. 1966 36 p refs
(RAE-TR-66324)

Most of the existing methods for calculating the inviscid flow past a delta wing with leading-edge vortices are based on slender-body theory. When these vortices are represented by rolled-up vortex sheets in an otherwise irrotational flow, some of the assumptions of slender body theory are violated near the centers of the spirals. The aim of the present report is to describe for the vortex core an alternative method in which only the assumption of a conical velocity field is made. An asymptotic solution valid near the center of a rolled-up vortex sheet is derived for incompressible flow. Further asymptotic solutions are determined for two-dimensional flow fields with vortex sheets which vary with time in such a manner that the sheets remain similar in shape. A particular two-dimensional flow corresponds to the slender theory approximation for conical sheets. Author

N67-35175 Royal Aircraft Establishment, Farnborough (England).
MINIMUM DRAG SURFACES OF GIVEN LIFT WHICH SUPPORT TWO-DIMENSIONAL SUPERSONIC FLOW FIELDS
J. Pike Sep. 1966 39 p refs
(RAE-TR-66305)

The two-dimensional surface giving minimum pressure drag for given lift coefficient in supersonic flow is considered. The method adopted is a small perturbation of a plane surface; the pressure is expressed as a power series in the perturbed slope and third order terms are neglected. The shape of the optimum surface is found to be a double wedge surface, with a single discontinuity in the surface slope. The compression surface is concave at the discontinuity for Mach numbers below about 1.4 and above 3, and between these it can be slightly convex. The performance in the case $\gamma = 1.4$ is compared with that of the plane wedge, and the improvement is found to be very small, except at hypersonic speeds when improvements greater than 1% are obtained. Similar results hold for waveriders (three-dimensional wing shapes) based on two-dimensional flow fields. Author

N67-35178 Gt. Brit. Ministry of Aviation, London. Aeronautical Research Council.
EXPERIMENTAL INVESTIGATION OF THE POSITIONS OF THE LEADING-EDGE VORTICES ABOVE SLENDER DELTA WINGS WITH VARIOUS RHOMBIC CROSS-SECTIONS IN SUBSONIC CONICAL FLOW
D. L. I. Kirkpatrick and J. D. Field HMSO, 1967 33 p refs Supersedes RAE-TR-66068; ARC-28153; See X66-21321
(ARC-CP-925; RAE-TR-66068; ARC-28153) HMSO: 6s 6d

The positions of the centers of the leading-edge vortices above four slender wings have been located at several angles of incidence using a Kiel tube probe, and measured using a mutual inductance method of distance measurement. This method was developed for use in this experiment to provide accurate information about the position of a probe in the flow field by measuring the mutual inductances between a coil on the probe and two coils fixed in the wing. The method enabled changes in the probe's position of 0.002 inch to be detected and measured without touching the probe itself or disturbing the flow field round it, and it is capable of being developed to give even greater accuracy. The variation with incidence of the positions of the centers of the vortices above four slender wings whose rhombic cross-sections have leading-edge angles of $\pi/6$, $\pi/3$, $\pi/2$ and $2\pi/3$ have been determined and are presented in this report. The results show how the development with incidence of the leading-edge vortices above such wings is affected by the size of the edge angle of the wings' cross-sections. Author

N67-36208*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC DATA ON LARGE SEMISPAN TILTING WING WITH 0.5-DIAMETER CHORD, SINGLE-SLOTTED FLAP, AND SINGLE PROPELLER 0.06 CHORD BELOW WING

Marvin P. Fink. Washington, NASA, Jul. 1967 203 p refs
(NASA-TN-D-4030) CFSTI: HC$3.00/MF$0.65 CSCL 01A

An investigation has been made in the Langley full-scale tunnel to determine the longitudinal aerodynamic characteristics of a large-scale semispan V/STOL tilt-wing configuration having a single propeller which was tested for both right- and left-hand modes of rotation. The model had a half-fuselage on which loads were measured separately. The wing had a ratio of chord to propeller diameter of 0.5, a 40-percent-chord single-slotted flap, an aspect ratio of 4.88 (2.44 for the semispan), a taper ratio of 1.0, and an NACA 4415 airfoil section. The data have not been analyzed in detail, but have been examined to observe the predominant trends. It was found that the direction of propeller rotation had a very significant effect on the lift and descent capability (as determined from drag-lift ratios attainable without stalling of any part of the wing within the propeller slipstream) and that up-at-the-tip rotation gave the more favorable results. The use of a trailing-edge flap was also very effective in increasing the descent capability. The use of flow-control devices (slat and fences) was very effective in increasing the descent capability and lift for the case of down-at-the-tip propeller rotation where the characteristics without such devices were poor, but was much less effective for the case of up-at-the-tip propeller rotation where reasonably favorable results were achieved without these devices. For the most favorable combination of the configuration variables, descent angles of nearly 29° were achieved over the entire test range of power conditions. Author

N67-35233 Royal Aircraft Establishment, Farnborough (England).
MEASUREMENTS OF PRESSURE FLUCTUATIONS AND SKIN-FRICTION ON THE UPPER SURFACE OF A SLENDER WING AT LIFT (M = 0.8 TO 2.0)
K. J. Turner and D. Walker Oct. 1966 54 p refs
(RAE-TR-66339)

Four slender-wing free-flight models were used to investigate the local pressure fluctuations, skin-friction and static-pressures across one spanwise station under varying conditions of lift and Mach number. At Mach numbers between 0.8 and 1.2 a well established free-vortex flow was achieved over the upper surface. The intention was to determine the ratio between the intensity of the pressure fluctuations and the local skin-friction under conditions of attached and separated flows. While measurements of reasonable quality were obtained, the inherent limitations of the telemetry system did not allow a sufficiently broad band of pressure-fluctuation frequencies to be measured so that the relationship with skin friction could not be determined. Therefore, a detailed analysis of the results and comparison with other experimental or theoretical data has not been attempted. But the present results are a significant addition to the rather meager experimental data that exist on this subject, because they were obtained in conditions free from flow imperfections such as free-stream turbulence in most wind tunnels. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N67-34013# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
ON THE CALCULATION OF THE MAXIMUM SOUND PRESSURE SPECTRUM FROM FIXED AND MOBILE JETS [SUR LE CALCUL DU SPECTRE DE PRESSION SONORE MAXIMALE EMIS PAR LES JETS STATIONNAIRES ET EN VOL]
Michel Kobrynski 1967 41 p refs In FRENCH; ENGLISH summary
(ONERA-TN-108(1967)) CFSTI: HC$3.00/MF$0.65

The calculation of the maximum sound pressure spectrum from turbojets of airplanes on their takeoff trajectory is based on the generalized expression of acoustical power emitted by the fixed or moving axisymmetric jets; it takes account of the laws of spatial distribution of the sound energy and of the generalized characteristics of the linear maximum sound pressure spectrum at a given distance of reference (30 m). The numerical solutions of the equations obtained are facilitated by the use of diagrams and necessitate knowing geometrical and aerodynamic parameters of the jets and also the airplane speed. Author (ESRO)

N67-34025# Technology, Inc., Dayton, Ohio.
CONTINUED STUDY OF RANDOM ALTITUDE DEVIATIONS OF GENERAL AVIATION AIRCRAFT DURING CRUISE Final Report
Larry E. Clay, Robert J. Marshall, and Joseph F. Braun, Jr. Jan. 1967 58 p refs
(Contract FA-65-WA-1163)
(SRDS-RD-67-8) CFSTI: HC$3.00/MF$0.65

In a continued flight technical error study of general aviation aircraft to investigate the random deviation of such airplanes from their intended cruise altitude, the cruise sections from more than 1000 hours of recorded data were stratified by five variables: (1) airplane type, (2) cruise altitude range, (3) flight rules (instrument or visual), (4) type of altitude control (manual or autopilot), and (5) pilot experience. Data were collected from eight airplanes representing six airplane types: F-27, Apache, Cessna 337, Beechcraft Musketeer, Cessna 182, and Aero Commander. Most significant among the conclusions drawn was that the altitude deviations are substantially lower when the airplanes are operated with autopilot. Author

N67-34045 Royal Aircraft Establishment, Farnborough (England).
A COMPUTER AND FLIGHT INVESTIGATION OF THE EFFECTS OF LOCALIZER NOISE AND WIND GUSTS ON AUTOMATIC LANDING LATERAL PERFORMANCE
G. Musker Dec. 1966 21 p refs
(RAE-TR-66385)

An analog computer study and flight tests are described in which the automatic landing lateral performance of an aircraft using different guidance control laws is examined. The effect on performance of course bends on the I.L.S. localizer, which just satisfy the I.C.A.O. Category II specification, is also examined. The study shows that a system using integral-bank stabilization has a better tolerance to beam noise and wind than one using beam-rate stabilization. However, with either system the Category II course bend specification, if extended to ground level, allows acceptable performance at touchdown. Author

N67-34208# Dynasciences Corp., Blue Bell, Pa.
DYNAGYRO—A MECHANICAL STABILITY AUGMENTATION SYSTEM FOR HELICOPTERS Final Report, 26 May 1965–30 Oct. 1966
M. George, E. Kisielowski, and A. A. Perlmutter Mar. 1967 139 p refs
(Contract DA-44-177-AMC-286(T))
(DCR-221; USAAVLABS-TR-67-10; AD-654046) CFSTI: HC $3.00/MF$0.65

The report presents the results of an investigation of the design and performance characteristics of a compact and lightweight stability augmentation system for helicopters. This system, known as the DYNAGYRO, consists of a two-degree-of-freedom coulomb damped gyroscope which is mounted within the helicopter fuselage. The investigation includes an analog computer study, a comprehensive component test program, and a bench test performance evaluation of a laboratory test model. The results obtained from the investigation showed that the DYNAGYRO provides stability augmentation characteristics which compare favorably with those of the much larger and heavier rotor hub-mounted devices. Author (TAB)

N67-34380 Royal Aircraft Establishment, Farnborough (England).
CHARACTERISTICS OF THE STRESS FREQUENCY DISTRIBUTION OF THE WING LOWER SURFACE OF MODEL BOEING 727 FROM FLIGHT MEASUREMENTS [KENNWERTE DES SPANNUNGSKOLLEKTIVS DER FLUGELUNTERSEITE BOEING 727 AUS EICH-UND MESSFLUGEN]
O. Buxbaum Jun. 1967 49 p refs Transl. into ENGLISH from the GERMAN Rept. FB-64, 1966
(RAE-LIB-TRANS-1233; FB-64)

On a Boeing 727 of Lufthansa, cg vertical accelerations and lower spar boom stresses have been continuously recorded over 30 normal service flights and statistically analysed. The absolute stress levels were fixed by means of a flight calibration test. It is shown how the stress frequency distribution for a highly loaded area of lower in-spar skin can be estimated from the results by means of extreme value distributions and the static test data supplied by the aircraft manufacturer. Author

N67-34441# Defence Research Medical Labs., Toronto (Ontario).
TRIALS OF AN SK-5 HOVERCRAFT FOR THE CANADIAN COAST GUARD
R. E. F. Lewis, J. W. Storr, and F. C. Brewer Apr. 1967 82 p refs
(DRML-667)

A trial was conducted to test the suitability of an SK-5 hovercraft in representative Coast Guard maneuvers and operations. Typical operations were studied in smooth and rough water by day and night and included transfers between the hovercraft and larger vessels, towing vessels of varying size, man rescue, barge operations, firefighting, locking, anchoring in fast water, long distance runs in poor visibility, measurement of noise, stopping distances, and speed. The hovercraft performed effectively in almost all tests and operated well in quite rough water. The study concluded that the hovercraft can effectively perform Coast Guard duties and can extend its rescue facilities. R.N.A.

N67-34455 Library of Congress, Washington, D. C. Aerospace Technology Div.
DEVELOPMENT OF SOVIET SUPERSONIC TRANSPORT EQUIPMENT AND SUBSYSTEMS. PART I: ANALYTICAL SURVEY OF MATERIALS. PART II: ABSTRACTS Surveys of Foreign Scientific and Technical Literature
Aleksander Dolgich 9 May 1967 134 p refs
(ADT-67-27)

Abstracts of technical materials on SST configuration, aerodynamic features, power plant, economic and safety factors, and present and long-range aerospace transportation programs are presented. Selection was made from open sources stressing those materials which contain data most likely to see direct application in the SST program. Using the abstracts as a base, an analytical survey on Soviet supersonic equipment methodology and concepts is given. A brief listing of pertinent facilities and personalities is included. E.C.

N67-34457# College of Aeronautics, Cranfield (England).
AEROPLANE DESIGN STUDIES. PROPELLER TURBINE AND PURE JET POWERED GENERAL PURPOSE TRANSPORT AIRCRAFT
D. Howe May 1967 60 p refs
(COA-AERO-197)

Two air bus conceptions of air travel were studied. The first study was based upon the use of four propeller turbine engines to power an aircraft capable of carrying up to 40,000 lb. of payload over short stage lengths. Emphasis was placed on the need for operations with mixed passenger and freight loads and the fuselage layout incorporates two decks, the lower one of which is designed as a freighthold with nose loading doors. The second study was similar except that four wing mounted pure jet engines replaced the propeller turbines of the earlier design. The cruising speed is thus some 50% higher with a Mach number limitation of 0.8. An initial economic comparison of the two aircraft revealed that when the aircraft are operated over 250 n. mile stage lengths the direct operating costs of the propeller turbine powered design are some 20% less than those of the pure jet version. Author

N67-34463*# Northrop Space Labs., Hawthorne, Calif. Norair Div.
AIRCRAFT PRELIMINARY DESIGN REPORT V/STOL JET OPERATIONS RESEARCH AIRPLANE DESIGN STUDY. VOLUME I AIRPLANE SPECIFICATION FOR NORTHROP N-309 NASA V/STOL JET OPERATIONS RESEARCH AIRPLANE
Jul. 1967 170 p refs
(Contract NAS1-6777)
(NASA-CR-66417) CSCL 01C

Design specifications for the Northrop N-309 NASA V/STOL jet operations research aircraft are presented. The specifications cover the aircraft's performance characteristics, general design and construction features, aerodynamics, structural design criteria, wing group, tail group, body, alighting gear system, flight control systems, engine sections, propulsion, secondary power and distribution system, utilities and equipment items, mission and traffic control subsystems, mission subsystems, armament, and ground handling and servicing provisions. R.N.A.

N67-34494# McGill Univ., Montreal (Quebec). Mechanical Engineering Research Labs.
AN EVALUATION OF METHODS FOR PREDICTING THE PERFORMANCE OF PROPELLERS OPERATING AT ZERO ADVANCE RATIO
David C. Gilmore Apr. 1967 62 p refs
(Grant DRB-G-9551-12)
(TN-67-2) CFSTI: HC $3.00/MF $0.65

Several methods by which the performance of a propeller operating with zero forward speed can be evaluated are reviewed. Most methods are also applied to a particular case in which thrust and power gradings have been measured. Few methods provide accurate predictions of the thrust and torque distributions. Several of the existing theories such as momentum theory and those of Knight and Hefner, Goldstein, and Theodorsen need modification in order to be applied. Most modified methods give reasonably accurate integrated values of thrust and power but lead to erroneous distributions of these quantities. All the methods discussed, except the single point methods, require strip analysis to obtain thrust and power distributions. The applicability of strip analysis itself is examined, using measured inflow velocities. Author

N67-34536* International Information, Inc., Philadelphia, Pa.
EFFECT OF SONIC BOOMS ON THE PUBLIC
G. Chevallier and J. Perrochon Washington, NASA, Jan. 1967 29 p Transl. into ENGLISH of Centre d'Essais en Vol Service Methodes Rept.-DE-01802, 1965 30 p
(Contract NASw-1499)
(NASA-TT-F-10709) CSCL 01B

Sonic booms were simulated by explosions of a charge near the ground, and personnel of the Flight Testing Center at Bretigny were polled on their impressions by means of a statistically adequate questionnaire. The location of the subject (building, floor, and exposure window open or closed) and the personal impression (not bothersome, slightly bothersome, annoying, painful, or very painful), along with sex and age, were recorded, and the data are tabulated. Limitations in the test procedures are mentioned, and the preliminary conclusions are presented in tabular form. N.E.N.

N67-34630 National Research Council of Canada, Ottawa (Ontario).
REPORT ON AIRCRAFT TURBINE ENGINE BIRD STRIKE INVESTIGATIONS
O. N. La Ham 17 Jan. 1967 37 p *Its* Field Note No. 43
(CM4-S-17-2)

The high incidence of bird strikes affecting the Canadian Forces flying program necessitated an immediate investigation to establish unequivocal methods of determining whether or not engine failure was due to the ingestion of a bird or some other cause. The application of microscopic methods and the use of amino acid analysis of protein residues are described and the results obtained presented. It is now evident that air crashes resulting from a bird strike can be determined with certainty and it is suggested that the amino acid analysis may emerge as a definite method for identifying specific bird types and in this way substantially assist in the ultimate solution to the bird strike problem. Author

N67-34660# National Research Council of Canada, Ottawa (Ontario).
A MOMENTUM RULE FOR OPTIMUM AIRCRAFT PERFORMANCE IN THE V/STOL TRANSITION REGIME
R. J. Templin Jan. 1967 50 p refs
(LR-470; NRC-9639) CFSTI: HC $3.00/MF $0.65

By applying momentum theory to lifting wings and to propulsion systems with deflected thrust, it is shown that when these components are combined in a single lifting system, minimum ideal thrust or power is required in any flight condition when the momentum deflection angles of the wing wake and of the propulsive jet or slipstream are approximately equal. Those V/STOL aircraft systems having closely coupled or "integrated" wing and propulsive flows may more or less automatically satisfy this general rule, and therefore might be expected to approach minimum ideal thrust or power requirements. Comparisons of the theory with available flight and wind tunnel performance measurements for a variety of V/STOL aircraft types seem to bear out this prediction even when the lift due to power does not extend across the whole wing span, provided only that wing stalling is prevented. Author

N67-34663 Aeronautical Research Council, (Gt. Brit.).
THE RANGE PERFORMANCE OF HYPERSONIC AIRCRAFT
D. H. Peckham and L. F. Crabtree 1967 25 p refs Supersedes RAE-TR-66178; ARC-28392; see X67-12069
(ARC-CP-932; RAE-TR-66178; ARC-28392) HMSO: 5s 6d

A simple analysis is given of the range performance of hypersonic aircraft. Some relatively crude approximations are used to enable the range covered during acceleration and final glide, which can be a considerable fraction of the total range, to be taken into account. Typical calculations show that global ranges (i.e. of the order of 10000 nm) are obtainable for reasonable values of lift to drag ratio and of specific fuel consumption, and a fuel weight of less than 50% of the take-off weight, with liquid hydrogen fuel. Comparative calculations of the volume requirements of such aircraft with kerosene and liquid hydrogen fuel are made. These show that a long-range hypersonic aircraft needs to be of a rather large size to make full use of the advantages of liquid hydrogen fuel, and that the penalty is quite severe for a small aircraft due to the reduction in the ratio of lift to drag with increasing volume. Author

N67-34706*# Northrop Space Labs., Hawthorne, Calif. Norair Div.
AIRCRAFT PRELIMINARY DESIGN REPORT V/STOL JET OPERATIONS. RESEARCH AIRPLANE DESIGN STUDY. VOLUME II: AIRPLANE SPECIFICATION FOR NORTHROP MODIFIED T-39A NASA V/STOL JET OPERATIONS RESEARCH AIRPLANE
[1967] 146 p
(Contract NAS1-6777)
(NASA-CR-66418) CFSTI: HC $3.00/MF $065 CSCL 01C

The general design requirements and guidelines for specifications are outlined for the V/STOL configuration to conduct research and gather engineering data on the performance and stability and control characteristics needed by fighter-type aircraft in hovering and transition speed range. The vehicle, and its systems, components, and equipment are discussed. A list of equipment which could be anticipated as GFAE items on military production contracts is appended. The state-of-the-art for stability augmentation and the variable stability systems, and appropriate hardware available at the present are included. N.E.N.

N67-34741 International Civil Aviation Organization, Montreal (Quebec).
AIRWORTHINESS COMMITTEE: SEVENTH MEETING
15 Dec. 1966 148 p Meeting held in Montreal, Canada, 22 Nov.–15 Dec. 1966
(DOC-8653-AN/887)

Technical discussions and recommendations on the following agenda items are reported: (1) Development of a uniform calibration method for determining static pressure system error. (2) Development of uniform test procedures for Type III altimeters. (3) Revision of the PAMC on turbine engine-type tests. (4) Provisions to enable aircraft to withstand bird strikes—preparation of PAMC material. (5) Structural problems—preparation of PAMC on gust criteria. (6) Revision of PAMC on airplane performance. (7) Flying qualities—(a) consideration of additional material for the PAMC on airplane flying qualities including such matters as dynamic stalls and unconventional identification of stalls, out-of-trim conditions and rate of roll; and (b) preparation of draft PAMC material on dynamic stability characteristics. (8) Exchange of views on: (a) crash fires including interrelated aspects of human survivability; (b) draft SST specifications; (c) effect of flight in turbulence on flying qualities; (d) performance implications of the use of contingency power; (e) flying qualities of new forms of aircraft (VSTOL, STOL, and SST); (f) post-certification airworthiness of exported aircraft. (9) Preparation of revised work program. (10) Tentative agenda for the Eighth Meeting and assignment of tasks to members. (11) Plans for the Eighth Meeting. S.C.W.

N67-34760 Aeronautical Research Labs., Melbourne (Australia).
LOADING ACTIONS ON AN AGRICULTURAL PROSPECTOR AIRCRAFT
J. Visick Aug. 1966 35 p refs
(ARL/SM-309)

A comparison is made, for a number of flights, of the loads encountered by the Prospector agricultural aircraft when turning,

dusting or spraying, and flying straight and level. It has been found that there are significant differences in the shape of the g spectra for each of these phases of flight. Strains at several points on the aircraft have also been measured and an attempt made to obtain a relationship between strain, 'g', and aircraft weight. A spectrum of ground loads has been obtained for a number of take-offs and landings and a comparison made between a grass aerodrome surface and field grass strip. An accuracy test has also been made on the performance of the semi-automatic machine that was used to read the recording film. Author

N67-34810
SONIC BOOM [BANG SONIQUE]
May 1967 58 p refs In ENGLISH and FRENCH

Permissible noise tolerance levels from sonic boom over cities is theoretically discussed. Shock wave propagation patterns are presented on propagation to a point traveling at subsonic speed, and to a point at supersonic speed. A complete answer to the problem of sonic boom damage over populated areas requires further study. R.Li.

N67-34978 Brussels Univ. (Belgium). Institut d'Aeronautique.
EXPERIMENTAL AIR-CUSHION VEHICLE PV-1. FLIGHT TESTS (VEHICLE SUPPLIED WITH FLAPS) [VEHICULE EXPERIMENTAL A COUSSIN D'AIR PV-1. ESSAIS EN VOL (VEHICULE MUNI DE JUPES)]
A. Jaumotte, A. Kiedrzynski, and M. Lejeune 1967 34 p refs In FRENCH
(NT-12-1967; Rept.-5)

Flight performance, pitch and roll stability, jet configuration, and maneuverability were analyzed for an air cushion vehicle with flaps. Consideration is given to the propulsion system which takes advantage of the peripheral jet. R.Li.

N67-34979 Brussels Unnvp (Belgium). Institut d'Aeronautique.
PERIPHERAL JET AIR CUSHION VEHICLE. ENERGY STUDY OF MIXED PROPULSION (DEVIATION OF LONGITUDINAL PARTS OF A JET LIFT) [VEHICULE A COUSSIN D'AIR A JET PERIPHERIQUE. ETUDE ENERGETIQUE DE LA PROPULSION MIXTE (DEVIATION DES PARTIES LONGITUDINALES DU JET DE SUSTENTATION)]
A. Jaumotte, A. Kiedrzynski, and G. Van De Steen 1967 42 p refs In FRENCH Sponsored by DRME
(Rept.-4; NT-11)

Preliminary calculations and a numerical example are presented in a study on the peripheral jet of an air cushion vehicle. The power for this glider-type, mixed-propulsion vehicle is furnished partly by a propeller and partly by the reaction of an opposing jet. Floats in peripheral slits aid in the deviation of the jet. Transl. by R.Li.

N67-35029*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
RESULTS OF A BRIEF FLIGHT INVESTIGATION OF A COIN-TYPE STOL AIRCRAFT
Terrell W. Feistel and Robert C. Innis Washington, NASA, Aug. 1967 39 p refs
(NASA-TN-D-4141) CFSTI: HC $3.00/MF $0.65 CSCL 01C

The aircraft tested to gain experience with a COIN (for COunter INsurgency) type STOL aircraft had two propellers driven by turbine engines, and double-hinged, single-slotted flaps to deflect the slipstream on the largely immersed wing. It was capable of good low-speed performance and had acceptable handling qualities in the STOL regime (with landing and take-off distances consistently less than 800 feet over a 50-foot obstacle), provided the possibility of engine failure was ignored. This performance was achieved, despite flaps with only medium effectiveness, because the aircraft had a low aspect ratio, a high power loading, and a no-flare landing gear design. It is shown that the performance of the test aircraft, as flown (ignoring engine failure), compared favorably with that of a large four-engined STOL aircraft, tested previously, which was much more sophisticated (it included a fail-safe propulsion system). If flown above the minimum single-engine control speed, in compliance with the normal safety restrictions for twin-engine airplanes, major aspects of the performance of the test aircraft are no better than that obtainable with many small twins in current production and most of the original objectives of the COIN concept are compromised. Author

N67-35031 Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Suresnes (France).
PROBLEMS OF NOISE AROUND AIRPORTS AND MEASURES TO REDUCE IT [LES PROBLEMES DU BRUIT AUTOUR DES AEROPORTS ET LES MOYENS DE SA REDUCTION]
G. Richter and R. Hoch [1967] 51 p refs In FRENCH Presented at 8th Congr. Intern. Aeron., Paris, 29–31 May 1967

Human reactions to exterior aircraft noise around an airport are assayed in a study of the problem of noise attenuation of sonic boom. Screening is mentioned as one method of ground absorption of the noise. Tip speed limitation and modification of blade wakes are considered as possible ways of reducing fan noise at source. The study is in application to the Concorde and SST (supersonic transport) aircraft. Transl. by R.Li.

N67-35099 Elliott Bros., Ltd., London (England). Transport Aircraft Controls Div.
LOW VISIBILITY OPERATION FOR THE SST CONCORDE USING DUPLICATE MONITORED SYSTEMS TO ACHIEVE AUTOMATIC FAILURE SURVIVAL
D. Marshall [1967] 18 p Presented at the 8th Intern. Aeron. Congr., Paris, May 1967
(Rept.-280-TP-391)

Information derived during the design and flight testing of the VC-10 aircraft automatic touchdown system is presented; and means of applying the results to the Concorde supersonic transport automatic flight control system are illustrated. The Concorde aircraft is being developed with a design objective of at least Category 3A operation which requires that the aircraft be controlled to touchdown with a runway visual range of as low as 700 ft. Areas where careful system design can lead to significant improvements in the merit of the automatic landing system intended to meet the Category 3 certification requirements are examined. The safety requirements for duplicate monitored operation, and the practical aspects of in-line monitoring and changeover techniques are discussed. L.S.

N67-35153 London Univ. (England). Dept. of Aeronautical Engineering.
THE ROLE OF FLUTTER DERIVATIVES IN AIRCRAFT STABILITY AND CONTROL
R. D. Milne Jul. 1966 24 p refs

Beginning with the integral-differential equations of motion, a method for calculating the response to arbitrary inputs is developed which is closely analagous to that used in the quasi-steady case and retains its desirable features. The method uses the flutter derivatives as the basic aerodynamic data. The response is not valid for very rapidly decaying motions, but this type of restriction is also inherent in the Fourier inversion technique unless flutter derivatives are available for very large frequency parameters. Solutions of the equations are given for a numerical example for a simple, classical binary system for a rigid wing having plunging and pitching freedoms. L.S.

N67-35159# Cornell Univ., New York. Daniel and Florence Guggenheim Aviation Safety Center.
SURVEY OF RESEARCH PROJECTS IN THE FIELD OF AVIATION SAFETY Annual Supplement, for 1967
1967 96 p refs

The list of safety projects covers the areas of : 1) airplane design, 2) aircraft maintenance, 3) aircraft instrumentation, 4) airports and runways, 5) accident prevention and protection (e.g. seats, harnesses and belts), 6) personnel education and training, 7) communications, 8) electrical, hydraulic, and pneumatic equipment, 9) flight testing, 10) fuels and lubricants, 11) materials, 12) meteorology, 13) military operations, 14) navigation, 15) operating problems, 16) jet and turbine power plants, 17) rotary wing aircraft, and 18) structures. L.S.

N67-35174 Royal Aircraft Establishment, Farnborough (England).
INVESTIGATION OF STATIC BUILD-UP ON HELICOPTERS WITH PARTICULAR REFERENCE TO WHIRLWIND Mk.10s Interim Report
M. E. Rogers and Elsie B. Minihan May 1966 63 p refs
(RAE-TR-66152)

Charging mechanisms, hazards arising and possible methods of reducing aircraft potentials are discussed. Analysis of data established that Whirlwind 10s suffer from an inherent, engine-generated charging current and a theory is put forward to explain the charge transfer mechanism. Atmospheric charging data revealed that heavy precipitation associated with Cu–Nb clouds represents the most serious threat to lifting operations, particularly in the British Isles. Passive dischargers were evaluated as a possible interim solution and the results are discussed in relation to cargo and personnel lifting operations. The possibility of extracting negative charge from the exhaust gases was studied but found to be an inefficient means of control. Recommendations are made to help safe-guard cargoes and crews engaged in lifting operations, pending the introduction of an Active Discharge System. Author

N67-35191 National Research Council of Canada, Ottawa (Ontario).
INTERNATIONAL COOPERATIVE RESEARCH
M. S. Kuhring 20 Jul. 1966 17 p
(CM4-S-17-2)

A detailed account is presented describing how a committee on bird hazards to aircraft has functioned, especially in interdepartmental matters, in initiating an international cooperative research project on this problem. Several areas for international cooperation are suggested and include the collection of data, the exchange of information, formal and informal discussions, ecological surveys, and the detection and prediction of bird movements by radar. Methods of solving the bird hazard problem are discussed and include microwaves, increasing aircraft airworthiness, tape recordings of bird distress calls, pyrotechnics, devices to keep birds away from ponds, narcotics and poisons, alternative ground cover, growing crops that do not attract birds, and evicting birds from airport buildings. R.N.A.

N67-35194# Royal Aircraft Establishment, Farnborough (England).
RESONANCE TESTS ON A BEAGLE B206 SERIES 1 AIRCRAFT
F. J. Hawkins and R. F. Mousley Oct. 1966 45 p refs
(RAE-TR-66309) CFSTI: HC $3.00/MF $0.65

The modes of vibration in the frequency range up to 47.4 Hz were investigated with multipoint excitation using the automatic ground resonance testing equipment. The modes obtained are discussed. Comment is also made on the short time and small effort required to conduct these tests. Author

N67-35201# Canadian Forces Headquarters, Ottawa (Ontario).
BIRDSTRIKES, 1966
1966 23 p

A monthly tabulation of bird strikes on aircraft reported in Canada and Europe between 1957 and 1966 is presented; and detailed reports are included for 1965 and 1966. A marked increase in numbers for 1966 is attributed to better reporting procedures. Data are summarized for five confirmed bird strikes that ended up in the destruction of CF-104 aircraft; and bird strikes reported in 1966 by Canadian Forces are detailed by month, location, species, type of aircraft, and general remarks. M.W.R.

N67-35248# Italy. Ministero Difesa Aeronautica, Rome.
NEW PROCEDURE FOR DETERMINATION OF THE COORDINATES OF THE CENTER OF GRAVITY OF AN AIRCRAFT [METHODO PER IL RILEVAMENTO DELLE COORDINATE DEL CENTRO DI GRAVITA DI UN VELIVOLO]
Michele Cassetti 1966 18 p refs In ITALIAN; ENGLISH summary
(Rept.-26) CFSTI: HC $3.00/MF $0.65

The procedure for determining the coordinates of the center of gravity in the symmetry plane of an aircraft is presented. The engineering design requires special tools for difficult, slow and dangerous operations which increase according to the size of the aircraft. The procedure described is not limited by the size of the aircraft, and the tooling is negligible. The method is based on the law of variation of the reaction on one of the supports of the aircraft as a function of the angle of inclination of the aircraft. The procedure is simple and affords great precision. Transl. by R.U.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N67-34069*# Douglas Aircraft Co., Inc., Newport Beach, Calif. Astropower Lab.
DEVELOPMENT OF ONE AMPERE-HOUR HEAT STERILIZABLE SILVER–ZINC CELL Final Technical Evaluation Report, Period Ending Jun. 1967
A. Himy Jul. 1967 118 p ref
(Contract NAS2-3819)
(NASA-CR-73110; SM-49109-F) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Mechanical and electrical problems in the development of an inorganic separator for use in a primary, heat sterilizable silver-zinc cell with space mission applications were investigated. Two designs, a cylindrical configuration and a conventional rectilinear configuration, were followed in studying the terminal and cover-to-case seals. For the rectilinear configuration, the sealing capabilities of heat resistant polysulfone and polyphenylene oxide were tested using ultrasonic and hot gas welding. A cell pack design was fabricated consisting of two positive electrodes and one negative electrode restricted in a cavity, sealed on three edges and partially on top, and having two rigid inorganic separators. After heat sterilization, various tests were conducted on the cell. These included continuous cycling, vibration, acceleration, survival, and wet stand. Results obtained for the inorganic separator and sealant materials show good poetntial for inclusion in functional designs for specific missions. E.C.

N67-34235* Martin Co., Denver, Colo.
OPTIMIZATION OF HYDRAULIC THRUST VECTOR CONTROL SYSTEMS FOR LAUNCH VEHICLES. VOLUME II: COMPUTER PROGRAM DESCRIPTION, INSTRUCTIONS, AND LISTING
Jan. 1965 83 p
(Contract NAS8-11415)
(NASA-CR-65596; CR-65-5, Vol. II) CFSTI: HC $3.00 CSCL 22C

The optimization of hydraulic thrust vector control systems for launch vehicles based upon reliability, performance and weight is discussed. The systems considered were for the Saturn F-1 and J-2 engines. The two parameters of the hydraulic system which could be adjusted for optimization were the system pressure and the engine-actuator moment arm. The general approach used for this study was to derive mathematical model equations which represented the system weight, reliability, etc. solve these equations (using a digital computer) for various combinations of moment arm and pressure, prepare graphs of the results, and then from the graphs determine which combination of the two system variables resulted in the best or optimal system. The selection of the optimum point required converting all characteristics to some common denominator. This was accomplished by converting each characteristic to a representative cost or dollar value to the program. Author

N67-34267# Naval Air Development Center, Johnsville, Pa. Aero-Electronic Technology Dept.
THE EVALUATION OF RHENIUM RESISTORS
J. F. Jones, Jr. 26 Apr. 1967 28 p
(NADC-AE-6711; AD-653715) CFSTI: HC $3.00/MF $0.65

Efforts leading to the development of sequential component deposition for process evaluation of rhenium resistors are reported. Preliminary results of component testing are discussed and are used to demonstrate the need for the new approach. Author (TAB)

N67-34363# Joint Publications Research Service, Washington, D. C.
APPROXIMATE DIFFUSION THEORY OF THERMIONIC CONVERTERS
A. F. Nastoyashchiy 14 Aug. 1967 5 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 23, no. 1, Jul. 1967 p 42–43
(JPRS-42212; TT-67-32842) CFSTI: HC $3.00/MF $0.65

Consideration is given to thermionic converters with surface ionization in terms of an application of the diffusion theory. A series of equations are derived to describe the functions discussed. The maximum achievable concentration of charged particles is determined by the Sakh equation. R.U.

N67-34629* Borden Chemical Co., Philadelphia, Pa. Central Research Lab.
IMPROVED SEPARATORS FOR SILVER OXIDE–ZINC AND SILVER OXIDE–CADMIUM CELLS FOR SPACECRAFT APPLICATION Quarterly Report
Helmuth L. Pfluger and Howard E. Hoyt Jul. 1967 33 p
(Contract NAS5-9107)
(NASA-CR-87822; QR-3) CFSTI: HC $3.00 CSCL 10C

Among the subjects discussed herein are experiments improving the conductivity of methyl cellulose membranes by precooling in aqueous alkali, or by pre-soaking in alkali solutions less concentrated than those to be used in the battery cell, as well as by formulating with various polar additives including tetramethylammonium hydroxide. Certain acrylic copolymer systems have been prepared as candidates for improved battery separators. Other work includes multiple wraps with alternating layers of different types of membrane. Author

N67-34659* General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
DESIGN OF A THREE-STAGE POTASSIUM VAPOR TURBINE. VOLUME II: MECHANICAL DESIGN
H. E. Nichols, R. W. Fink, and W. F. Zimmerman 20 Mar. 1967 355 p refs
(Contract NAS3-8520) (NASA-CR-72250) CSCL 10A

Design specifications and detailed descriptions are presented of a three stage potassium vapor turbine and its individual components and subassemblies. The turbine design is capable of 15,000 hours of operation at an inlet vapor temperature of 1550°F and a rotational speed of 18,250 rpm. The design comprises two phases: Phase I assembly with tip-shrouded turbine blades, and Phase II assembly with non-tip-shrouded turbine blades. The Phase I assembly is the primary design vehicle discussed, since it constitutes the most severe stress condition in the roton. Complete stress and vibration analyses, and a full set of drawings of the turbine components, including flowpath and main assembly, are included for both Phase I and Phase II assemblies. R.N.A.

N67-34734 Royal Aircraft Establishment, Farnborough (England).
INTERFERENCE PRODUCED BY RECURRENT THYRISTOR SWITCHING OF AC SUPPLIES
R. H. Forrest Jan. 1967 26 p refs
(RAE-TR-67013)

Recurrent switching of ac supplies by thyristors produces conducted radio interference signals. The nature of the interference spectrum is examined for a simple case, and the results are applied to the existing design of thyristor voltage regulator and a proposed type of cyclo-converter. Author

N67-34737* TRW Systems, Redondo Beach, Calif.
HEAT STERILIZED NICKEL-CADMIUM CELL ELECTRICAL PERFORMANCE INVESTIGATION Final Report, Phase III
R. F. Fogle and R. N. Richards Jun. 1967 100 p Prepared for JPL
(Contract NAS7-100; JPL-951092)
(NASA-CR-87815) CSCL 10C

The results of the heat sterilizable nickel–cadmium cell electrical performance investigation showed that initially a greater percentage (73 percent) of the sterilized cells had a higher capacity than comparable nonsterilized cells. At the termination of the test, only 45 percent of the sterilized cells showed a higher capacity than comparable nonsterilized cells. A comparison of capacity data showed that a greater percentage (73%) of the sterilized cells had higher capacities than comparable nonsterilized cells. There were some cells which exhibited irregularities of input and output capacities, that is, they showed high input capacities coupled with low output capacities or low input capacities coupled with almost equal output capacities. A higher percentage of the cells showing these irregularities had not been subjected to sterilization. The effect of increasing the discharge rate at a specific temperature resulted in decreasing the output capacity. In general, the input capacities increased as the temperature increased. The output capacities for a given discharge rate were low at 32°F (2.23 ampere hours), were a maximum at 75°F (3.51 ampere hours), and then fell off at 110°F (2.07 ampere hours). One cell (nonsterilized) failed during testing but it is doubtful the failure resulted from the cycle regime. Author

N67-34764*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT POWER
In its Space Programs Sum. No. 37–45, Vol. IV 30 Jun. 1967 p 22–41 refs (See N67-34761 20-30)

An overview is presented on the several photovoltaic evaluation systems being used to measure the electrical characteristics of

solar cells. These include the tungsten light source for illuminating test specimens at a color temperature of 2800°K; a small simulator for evaluating individual silicon solar cells at intensity levels of one solar constant or less; and a very flexible solar simulator light source, using a 19-lens lenticular system to filter a 2.5 kW zenon source in such a way that the resultant spectral distribution is essentially that of sunlight. Also discussed is the program for developing the necessary technology to achieve a power density of 20 W/lb for a folding, modular solar array having a deployed area of 1250 ft^2. Converter and generator developments for thermionic energy conversion systems are discussed, and parametric test results and performance data are depicted. Attention is focused on a high thermal conductance heat pipe device for solving the problems of heat transfer and distribution. M.G.J.

N67-34969# General Electric Co., Schenectady, N. Y. Research and Development Center.
MATHEMATICAL MODEL OF A PERMANENT MAGNET TIMING MOTOR
J. M. Lommel Dec. 1966 18 p refs
(Rept.-66-C-420)

The operation of a small, multipole permanent magnet motor used as a timing device has been simulated using DYNASAR software on a computer. The differential equation used to simulate the motor behavior was $I\ddot{\alpha} + R\dot{\alpha} = K \sin \omega t \sin P\alpha$. In this simplified model, the motor parameters I, R, and K were varied to determine for what values the motor would be self-starting, would run synchronously at the line frequency ω, and would continue to run in a stable fashion. A brute-force approach was adopted in finding solutions of rotor angular position and velocity as a function of time which led to stable behavior. For the case of zero damping, the range of parameters which gave stable operation was very small. Increasing the damping increased the range. For a fixed set of motor parameters and initial conditions only a narrow range of viscous damping coefficients led to stable behavior. Author

N67-35115*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SCREENING OF INORGANIC COMPOUNDS AS SOLVENTS
Harold F. Leibecki Washington, NASA, Aug. 1967 23 p refs
(NASA-TM-X-1427) CFSTI: HC $3.00/MF $0.65 CSCL 10C

The development of high-energy-density battery systems is hampered for want of electrolytes that are invariant in contact with electrodes fabricated from the materials found at either end of the electromotive force table. In an attempt to find a solvent that would be useful in making such an electrolyte, an investigation of inorganic compounds was conducted. The intent of this investigation was to screen those inorganic compounds which are liquid at room temperature and atmospheric pressure. The dielectric constant was chosen as the criterion for the screening. Measurements of the dielectric constant were made on those solvents with satisfactory physical properties. A total of 45 compounds were selected on the basis of their physical state, 11 of which had dielectric constants high enough to warrant further study. The 11 selected compounds and their dielectric constants are bromine pentafluoride, 40.2; bromine trifluoride, 42.6; hydrazine, 52.9; iodine pentafluoride, 97.6; phosphorus oxychloride, 13.8; selenium monochloride, 55.0; selenium oxychloride, 46.5; thionyl chloride, 11.5; sulfuryl chloride, 10.8; arsenic trichloride, 12.5; and arsenic trifluoride, 17.5. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N67-34016# Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Biophysics.
BIOLOGICAL SIGNIFICANCE OF HIGH MOLECULAR WEIGHT POLYPEPTIDES Final Report, Jun. 1, 1963–Jun. 30, 1966
Ephraim Katchalski [1964] 7 p refs
(Grants AF-EOAR-63-59; AF-EOAR-64-73)
(AFOSR-67-1208; AD-653641) CFSTI: HC $3.00/MF $0.65

The following topics were investigated: (a) Preparation and characterization of water-insoluble enzyme derivatives; (b) Artificial membranes with enzyme activity; (c) Use of polyamino acids in the study of cell membranes; (d) Interaction of polyamines with viruses. TAB

N67-34021* Cincinnati Univ., Ohio. Dept. of Pathology.
HYPOTHERMIC SUSPENDED ANIMATION Final Report
B. Black-Schaffer 1 Jun. 1967 8 p refs
(Grant NsG-75-60)
(NASA-CR-87449) CSCL 06B

Studies regarding the magnitude and degree of protection afforded by a combination of deep hypothermia and immersion in a fluid against accelerative stress, using mice, rats, and hamsters, are reviewed. A study of large mammalian hearts with particular reference to the presence and function of a fibroelastic internal membrane is discussed. Another study concerning the contraction rates of isolated heart muscle fibers from newborn animals with widely varying spontaneous cardiac rates is also discussed. Results indicate that the normal cardiac contraction rate is a reflection of the work load and that the relationship is direct. The studies are pertinent to an understanding of the chronic effects of reduced or null gravity upon the mammalian heart. L.S.

N67-34044*# Sandia Corp., Albuquerque, N. Mex.
A SEQUENTIAL DECISION MODEL OF PLANETARY QUARANTINE PRIMARY OBJECTIVES
C. A. Trauth, Jr. Jun. 1967 52 p refs
(NASA Order R-09-019-040)
(NASA-CR-87423; SC-RR-67-462) CFSTI: HC $3.00/MF $0.65 CSCL 06M

There is apt to be much uncertainty in any program of planetary exploration. This uncertainty leads naturally to possible uncertainty in the time period in which planetary quarantine is desirable and to possible uncertainty in the total number of missions to be launched in the vicinity of any given planet. A model is developed in this report which makes possible the derivation of mission non-contamination requirements without a priori knowledge of either the time period in which planetary quarantine is to be observed or the total number of missions to be used in exploring the planet in question. Author

N67-34093# Indiana Univ., Bloomington.
CHANGES IN THE ELECTROGASTROGRAM AND IN BREATHING AMPLITUDE AS INDICATORS OF NAUSEA
Michael M. Patterson Jun. 1967 19 p refs
(Contract Nonr-908(15))
(TR-18; AD-653462) CFSTI: HC $3.00/MF $0.65

From 35 human males subjected to Coriolis stimulation, the 12 Ss who reported feelings of nausea showed a significantly greater d.c. potential drift from the gastrointestinal (g.i.) area, recorded by the Davis method, and a larger respiration amplitude than those Ss who did not report such feelings. The results suggest that the measures of drift and breathing amplitude might be used as indicators of nausea. The fact that Cramptons (1955) intragastric recordings showed no such relation is discussed, and differences between his and the present experiments are analyzed. The results are interpreted as supporting the validity of the Davis method for recording g.i. activity in research of the present kind. Author (TAB)

N67-34105# School of Aerospace Medicine, Brooks AFB, Tex.
INDIRECT CALORIMETRY IN LOW PRESSURE ENVIRONMENTS, JANUARY–JULY 1966
Michael J. Ryan and Stephen M. Cain Mar. 1967 13 p refs
(SAM-TR-67-27; AD-653934) CFSTI: HC $3.00/MF $0.65

Equipment to measure energy exchange in low pressure environments was evaluated. A volume-summing apparatus with a proportional gas sampler, the Muller-Franz gas meter, proved to be reliable at barometric pressures of 447 and 259 torr (equivalent to 14,000 and 27,000 feet) for the measurement of minute volume of ventilation, oxygen uptake, and CO_2 production. Author (TAB)

N67-34236# Library of Congress, Washington, D. C. Aerospace Technology Div.
CBE FACTORS: MONTHLY SURVEY NO. 15
[1967] 259 p refs
(ATD-67-18; TT-67-62024; AD-652484) CFSTI: HC $3.00/MF $0.65

The report is one of a series of monthly surveys of Soviet, East European, and Chinese literature covering the following areas: Chemical factors (pesticides, herbicides, fertilizers, psychotomimetics, other chemicals); Biological factors (pathogens); Environmental factors (aerosols, ecology, micrometeorology, soil science). Available translations of additional sources pertinent to these subject areas, authors organizations, and an author index are included as appendixes. TAB

N67-34251 Flying Personnel Research Committee, London (England).
EFFECT OF ORIENTATION TO THE GRAVITATIONAL VERTICAL ON NYSTAGMUS FOLLOWING ROTATION ABOUT A HORIZONTAL AXIS
A. J. Benson and M. A. Bodin (Roy. Air Force) Jan. 1966 10 p refs
(FPRC/1247)

Following angular stimuli in yaw, the rate of decay of nystagmus was greater when the axis of rotation was horizontal than when it was vertical. The direction of the g-vector, when normal to the axis of rotation, had no consistent effect on the time constant of decay, though the angular velocity of nystagmus was greater in certain positions. Author

N67-34269# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
PATHOLOGY OF OXYGEN TOXICITY IN FORTY MACACA MULATTA
Farrel R. Robinson, David T. Harper, Harold P. Kaplan, and Anthony A. Thomas Mar. 1967 23 p refs
(AMRL-TR-66-234; AD-653526) CFSTI: HC $3.00/MF $0.65

Forty monkeys (Macaca mulatta) were exposed to 99-100% oxygen at pressures from 600 to 760 mm Hg. The acute exudative pulmonary response was seen in only three exposed at 760 mm Hg. The subacute proliferative pulmonary response was seen at all levels studied, the degree being directly related to time-dose exposures. In the high dose ranges clinical signs of illness were evident after 5-7 days exposure when the monkeys became listless and anoretic. By 14 days they were quite lethargic and had assumed a huddled position. Grossly, the heavy lungs had a gray, bloodless appearance. Microscopically, there was extreme proliferation of the interstitium and alveolar epithelium. None of the monkeys that were exposed at 600 mm Hg died, although mild focal proliferative changes were seen. After 31 days postexposure, these changes appeared as focal areas of atelectasis with mild septal fibrosis. Author (TAB)

N67-34288* Stanford Univ., Calif. Inst. for Mathematical Studies in the Social Sciences.
MATHEMATICAL MODELS OF MEMORY AND LEARNING
R. C. Atkinson and R. M. Shiffrin 20 Sep. 1965 82 p refs
Presented at the 3d Conf. on Learning, Remembering, and Forgetting, Princeton, N. J., 3–6 Oct. 1965
(Grant NGR-05-020-036)
(NASA-CR-87409) CFSTI: HC $3.00 CSCL 05J

The model presented encompasses both the retention phenomena emphasizing short-term memory and verbal learning emphasizing serial and paired-associate learning. Specific properties of the buffer are discussed in detail, and the transfer process to long-term store (LTS), the LTS, and the retrieval from memory are outlined. Short-term memory experiments are described and the application of the model to them is studied. Strength models for LTS and verbal recall models are also considered. Multiple-copy and strength-copy processes of storage in the LTS are compared, and an information model is discussed in which actual bits of information are stored rather than copies. N.E.N.

N67-34294# Kernforschungsanlage, Juelich (West Germany). Institut fuer Medizin.
MEASUREMENT OF WATER DISPLACEMENT IN MAN UNDER PHYSIOLOGICAL AND SOME PATHOLOGICAL STATES [MESSUNGEN VON WASSERVERSCHIEBUNGEN IM MENSCHEN UNTER PHYSIOLOGISCHEN UND EINIGEN PATHOLOGISCHEN ZUSTAENDEN]
Heinz Robert Scholz Mar. 1967 105 p refs In GERMAN
(JUL-471-ME) CFSTI: HC $3.00/MF $0.65

The total water content of the body was determined by the tritium and antipyrine tracer methods. The tritium water dilution method was modified for this purpose. The rhodanide space was used to measure the extracellular space. Total water content of the body and extracellular liquid of four volunteers was measured prior to and after extreme physical exercises which caused a mean water loss of 1545 ml within 50 minutes. Loss of body water total during the exercise was 3.29%, the extracellular space decreased 0.92%, and the intracellular space 5.03%. Measurement of the total body water, the extracellular liquid, and the intracellular liquid of 12 euthyreote patients established body weight means of 51.71%, 23.04%, and 28.67%. These results were compared with those of 9 patients whose hyperthyreosis was secured by radio iodine test. Similar measurements were performed on 3 female myxedema patients secured by radio iodine test. Examination of 4 persons to determine the decorporation of tritium showed that an extracorporal hemodialysis can reduce the biological half-life period from an average of 10 days to 5.4 hours. Transl. by K.W.

N67-34296# Massachusetts Inst. of Tech., Cambridge. Dept. of Nutrition and Food Science.
THE EFFECT OF REPEATED TREATMENT WITH GAMMA RAYS ON THE RADIO-RESISTANCE, VIRULENCE AND CULTURE CHARACTERISTICS OF CERTAIN PATHOGENIC AND RELATED BACTERIA
J. J. Licciardello, J. T. R. Nickerson, and S. A. Goldblith Washington, AEC, Feb. 1967 57 p refs
(Contract AT(30-1)-3325)
(TID-23707) CFSTI: HC $3.00/MF $0.65

A number of parameters which might influence radio-resistance of salmonella were investigated in order to adopt a uniform procedure for culturing, irradiating and recovering organisms whose radio-resistance was to be determined. There was not much difference in radio-resistance among 14- and 24-hour cultures, but 32- and 48-hour cultures were more radio-resistant. Oxygenation prior to irradiation decreased the decimal reduction dose by a factor of about three to four. Cultures grown at 37°C were more radio-resistant than cultures grown at 30°C or 20°C. The

radio-resistance of *Salmonella newport, S. thompson* and *S. heidelberg* was approximately the same whereas *S. typhimurium* was notably more radio-resistant. With regard to effect of temperature during irradiation, *S. typhimurium* was least resistant when irradiated at 43.3°C, more resistant at 0°C and most resistant at −17.6°C. Following high irradiation doses (about 10^{-6} % survival) a greater recovery of survivors generally resulted when petri plates were incubated at 37°C as compared to 20°C. Experiments to determine the effect of aerobic or anaerobic growth on radio-resistance did not yield consistent results with different salmonella serotypes. Salmonella grown at 37°C while exposed to a low flux of gamma radiation did not have an increased radiation resistance. A marked increase in radio-resistance occurred with cultures of *S. newport* which had been subjected to five irradiation cycles. With *S. typhimurium* a slight increase in radio-resistance was observed. Radio-resistant mutants of *S. newport* have been isolated by the double-irradiation plate method. Author (NSA)

N67-34343 Royal Aircraft Establishment, Farnborough (England).
EFFECT OF OXYGEN BREATHING ON THE FOLLOWING HYPOXIA
Haruo Ikegami and Iwao Takase May 1967 14 p refs Transl. into ENGLISH from Japan. J. Aerospace Med. Psychol., v. 2, 1965 p 57–63
(RAE-LIB-TRANS-1225)

Where the occurrence of sudden hypoxia, (inhalation of a very low oxygen concentration) caused by rapid decompression or other effects, can be visualized, it can be conceived that a prior inhalation of oxygen can extend the time of useful consciousness during hypoxia, or suppress or delay other harmful effects. However, since the quantitative relation between sustaining time and effect of oxygen breathing has not yet been clarified, it is impossible to determine the oxygen breathing time required for obtaining a maximum effect. Even should oxygen breathing be performed, its interruption would probably result in a gradual decrease in the effect which has once been achieved, but no relation between interruption time and attenuation in the effect of oxygen breathing has been clarified. The present study has been carried out in order to clarify these points and to evaluate quantitatively the effect of prior oxygen breathing against hypoxia. Author

N67-34348 Joint Publications Research Service, Washington, D. C.
BIOLOGICAL EFFECTS OF ULTRASOUND
C. I. Gorshkov and O. N. Gorbunov 26 May 1967 11 p Transl. into ENGLISH from Priroda (Moscow), no. 2, Feb. 1967 p 27–31
(JPRS-41169; TT-67-31810) CFSTI: $3.00

Physical properties, biological, and other effects of ultrasound are examined. Tests were conducted to determine the specific influences of ultrasound, at 28, 54, and 80 kcs, on the nervous system, the functions of the thyroid gland, the morphologic structure of the peripheral blood, and on several biochemical indices. An ultrasound siren was uniformly directed over the entire body surface of white rats and rabbits in a metallic sphere, one meter in diameter. The conditioned reflex activity of the animals changed after 10 minutes of exposure to an ultrasound of 120 decibels intensity. Thirty to sixty minutes following exposure, complete retardation of conditioned and unconditioned reflexes developed. Depression of the central nervous system by the ultrasound was confirmed following a study of the biopotentials of the cerebral cortex. Other reflex action, respiratofy, and hearing effects on the specimens, at ultrasound intensities ranging from 80 through 130 decibels, are discussed. E.C.

N67-34367 Joint Publications Research Service, Washington, D. C.
ELECTRONARCOSIS AND ELECTROSLEEP IN MAN AND ANIMALS
K. A. Ivanov-Muromskiy 15 Aug. 1967 52 p refs Transl. into ENGLISH from the book "Elektricheskiy Narkoz i Elektrosen Cheloveka i Zhivotnykh" Kiev, Izd. Naukova Dumka, 1966 p 9–13 61–75, 162–181, 221–222
(JPRS-42233; TT-67-32863) CFSTI: $3.00

Electric-current induced inhibition states of the central nervous system are surveyed in relation to the physiological mechanism of electronarcosis and electrosleep. Instrumentation and methodology are fully described, and the teachings of I. P. Pavlov regarding higher nervous activity are briefly delineated. Use of electrodes, and the effect of a pulse-current on the human CNS system are stressed. Further work in this and other ancillary areas is recommended. R.U.

N67-34369 Joint Publications Research Service, Washington, D. C.
PROPHYLAXIS OF VIBRATION DISEASES
N. N. Malinskaya and N. B. Metlina 25 May 1967 9 p Transl. into ENGLISH of the book "Profilaktika Vibratsionnykh Zabolevaniy" Moscow, 1966 p 3–5, 32–35
(JPRS-41154; TT-67-31795) CFSTI: $3.00

Vibrations occurring during the operation of cybernetic tools of percussion and rotary action are discussed in terms of prophylactic measures. These local vibrations can cause vibration diseases and are observed among workers engaged in the grinding and polishing of metal, marble working, and riveting operations, casting fettlers, and workers of other occupational groups. Preventive measures are very briefly outlined. R.U.

N67-34386 Royal Aircraft Establishment, Farnborough (England).
DANGER OF RADIATION DAMAGE TO THE EYES, ESPECIALLY LASER RADIATION [GEFAHREN VON STRAHLENEINR IRKUNGEN AUF DAS AUGE, INSBESONDERE DURCH LASERSTRAHLUNG]
F. Fankhauser and W. Lotmar May 1967 14 p refs Transl. into ENGLISH from Z. Angew. Phys. (Berlin), v. 6, 1966 p 521–524
(RAE-LIB-TRANS-1228)

After a short survey of possible radiation damage to the human eye by X-rays, neutrons, infrared and microwaves, the known facts about laser radiation damage are reviewed. Suitable filters for use in goggles, with or without the addition of interference filters are discussed. A list of safety rules to be observed when working with lasers is given. Author

N67-34391# Army Aeromedical Research Unit, Fort Rucker, Ala.
CONTINUOUS EKG RECORDING DURING FREE-FALL PARACHUTING
W. P. Schane and Kenneth E. Slinde Jun. 1967 32 p refs
(USAARU-67-7; AD-653598) CFSTI: HC $3.00/MF $0.65

An attempt was made to determine heart rate and rhythm of experienced parachutists during free-fall and during the periods immediately before and after the jumps. Continuous EKG recordings were made of 29 experienced parachutists while each participated in free-fall parachuting exercises. A total of 98 individual exits from aircraft in flight were recorded. Mean R-R interval was 0.403 seconds just prior to exit from the aircraft, 0.363 seconds during free-fall, 0.336 seconds immediately after parachute opening, 0.369 at landing, and 0.465 5 minutes after landing. Although there was variation in the R-R interval among individuals, the progressive decrease of R-R interval throughout the exit and free-fall with a nadir at parachute opening, was the common thing. There is marked individual difference in the duration of tachycardia before and after jumps. Over the entire group, mean duration per subject

was 19.4 minutes of tachycardia prior to exit, and 30.4 minutes of tachycardia after parachute opening. In the individuals who made at least 2 jumps on any one day, the R-R interval measured on a single individual on the first and second jumps were remarkably similar, and within the group not statistically different. A correlation matrix was computed to show relationships between various parameters studied. The correlation between R-R interval and total number of jumps was opposite in direction to that which was expected, and nearly attained values that were statistically significant.
Author (TAB)

N67-34412* St. Johns Univ., Jamaica, N. Y. Biology Dept.
[AN INVESTIGATION OF A SONO-CHEMICAL APPROACH IN STERILIZATION PROBLEMS] Final Semiannual Progress Report No. 6, 1 Jan.–30 Jun. 1967
Michael A. Pisano 30 Jun. 1967 8 p refs
(Grant NsG-684)
(NASA-CR-87494) CSCL 06T

Efforts to determine the efficacy of using ultrasound in combination with propylene oxide in problems of sterilization were continued. Previous obtained data are presented. In the last reporting period experiments were initiated to determine the sensitivity of spores of Bacillus stearothermophilus ATCC 7953 to airborne ultrasonic waves. The spores were transferred to suitable paper strips and exposed to sound in a manner previously described. Significance was determined by using Student's t test. A summary of the results with regard to significance at the 1% level, obtained at 30°C is given in a table. An identical pattern of results occurred at a temperature of 50°C. Attempts to increase the temperature to 60°C introduced several problems around the apparently greater sensitivity of the spores.
L.S.

N67-34433*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY—A CONTINUING BIBLIOGRAPHY, WITH INDEXES, JUNE 1967
Jul. 1967 169 p refs
(NASA-SP-7011(39)) CFSTI: HC $3.00/MF $0.65 CSCL 06S

A continuing bibliography is presented on aerospace medicine and biology. By means of these periodic supplements, it serves as a current abstracting and announcement medium for references in this field. It concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space.
R.U.

N67-34451*# Biosystems, Inc., Cambridge, Mass.
FEASIBILITY STUDY OF NONINVASIVE VENOUS PRESSURE MEASUREMENT
Richard F. Brubaker, Laurence R. Young, David M. Worthen, Joseph Pines, Ernst O. Attinger et al Apr. 1967 266 p refs
(Contract NASw-1559)
(NASA-CR-87444) CFSTI: HC $3.00/MF $0.65 CSCL 06S

The feasibility of modifying existing techniques or developing new methods for noninvasive venous pressure measurement under weightless conditions was investigated. Three methods were selected as prime candidates for early development: superficial vein pressure chamber occlusion, limb venous occlusion plethysmography, and digital plethysmography. The limb venous occlusion method indicates venous pressure in vessels not too far from the heart and also measures venous distensibility. However, its implementation is complex, and like the pressure chamber method, it is subject to drift due to changes in cabin pressure or temperature. The chamber pressure method is lightweight and simple to use, but may require astronaut training to correctly determine the end point. Although digital plethysmography may be easily adapted to physiological measurements in space, its major disadvantage is the distance at which the measurements are taken from the central venous system. Experiments using all three methods gave encouraging results and the development of one or more as space hardware is recommended.
R.N.A.

N67-34497# Imperial Coll. of Science and Technology, London (England). Electrical Engineering Dept.
NEURONAL OSCILLATORS
Jack D. Cowan Jan. 1967 32 p refs
(Contract N62558-4256)
(AD-653893) CFSTI: HC $3.00/MF $0.65

In order to identify the functional units of the nervous system a channel from neurophysiology to behaviour must be found. It is contended that such a channel is to be found in the study of neurodynamics, the shifting harmony of subpatterns, using precise mathematical models based firmly on experimental data.
Author (TAB)

N67-34501# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BIONICS RESEARCH
20 Dec. 1966 161 p refs Transl. into ENGLISH of the book "Issledovaniya Po Bionike" Kiev, Izd. Naukova Dumka, 1965 p 1–115
(FTD-HT-66-601; TT-67-62096; AD-653507) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. HYDRODYNAMIC CHARACTERISTICS OF THE MOVEMENT OF CERTAIN AQUATIC ANIMALS S. V. Pershin p 3–14 refs (See N67-34502 20-04)

2. SPEED OF WHALES AND CERTAIN CHARACTERISTICS OF THEIR EXTERNAL STRUCTURE A. V. Chepurnov p 15–32 refs (See N67-34503 20-04)

3. CREATION OF VERTICAL TRANSVERSE FORCES BY THE BODIES OF NEKTONIC ANIMALS Yu. G. Alexyev p 33–39 refs (See N67-34504 20-04)

4. STREAMLINING CHARACTERISTICS IN CALAMARIES F. V. Zuyev p 40–45 refs (See N67-34505 20-04)

5. CERTAIN MECHANICAL PROPERTIES OF THE TUBULAR BONES OF ANIMALS K. P. Mel'nik and N. F. Voronkin p 46–53 refs (See N67-34506 20-04)

6. CERTAIN PHYSICOCHEMICAL AND MECHANICAL PROPERTIES OF THE SYNOVIA AND ITS ROLE IN THE MECHANISM OF THE EXTREMITAL JOINTS A. G. Berezkin p 54–62 refs (See N67-34507 20-04)

7. MORPHOFUNCTIONAL ANALYSIS OF THE BRACHIAL MUSCLES OF CERTAIN UNGULATES A. D. Begeka p 63–73 refs (See N67-34508 20-04)

8. A MATHEMATICAL MODEL OF THE EXCITATION OF NERVE TISSUE Yu. G. Antomonov p 74–81 refs (See N67-34509 20-04)

9. INVESTIGATION OF THE PROPERTIES OF A MATHEMATICAL MODEL OF THE EXCITATION OF NERVE TISSUE WITH A CONTINUOUS-ACTION COMPUTER A. B. Kotova, L. I. Tushenkov, and Yu. G. Antomonov p 82–92 refs (See N67-34510 20-04)

10. ELECTRIC MODELING OF BOND OSCILLATIONS IN NUCLEIC ACID AND DETERMINATION OF NUCLEOTIDE SEQUENCE V. Ya. Malayev, I. N. Todorov, and V. A. Kashpur p 93–104 refs (See N67-34511 20-04)

11. A FREQUENCY METHOD FOR INVESTIGATING INFORMATION TRANSMISSION THROUGH THE CEREBRAL SYNAPSES B. Ya. Pyatigorskiy p 105–116 refs (See N67-34512 20-04)

12. ONE METHOD OF RECOGNIZING A LIMITED SET OF WORDS V. A. Dolyatovskiy p 117–130 refs (See N67-34513 20-05)

N67-34502# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HYDRODYNAMIC CHARACTERISTICS OF THE MOVEMENT OF CERTAIN AQUATIC ANIMALS [K GIDRODINAMICHESKOY KHARAKTERISTIKE DVIYHENIYA NEKOTORYKH VODNYKH YHIVOTNYKH]

S. V. Pershin *In its* Bionics Res. 20 Dec. 1966 p 3–14 refs (See N67-34501 20-04)

Examined are the locomotion forces and hydrodynamic characteristics of certain fish, cetaceans, and cephalopods with a view toward application of the findings to the designing and engineering of submerged bodies. It is noted that the natural submarine movement of these aquatic animals combines motive force with the propulsion mechanism without the use of intermediate links, that the movement is nonstationary cyclic in character, and that elements are used for reducing hydrodynamic resistance and controlling and smoothing the boundary layer flow. K.W.

N67-34503# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SPEED OF WHALES AND CERTAIN CHARACTERISTICS OF THEIR EXTERNAL STRUCTURE [SKOROSTI DVIZHENIYA KITOV I NEKOTORYYE OSOBENNOSTI IKH VNESHNEGO STROYENIYA]

A. V. Chepurnov *In its* Bionics Res. 20 Dec. 1966 p 15–32a refs (See N67-34501 20-04)

This article deals with the morphological adaptation associated with the speed and behavior of whales. Whales of commercial value and having different ecologies, behavior patterns, and speeds are considered. Many of the hypotheses advanced are preliminary and require experimental verification. Author

N67-34504# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CREATION OF VERTICAL TRANSVERSE FORCES BY THE BODIES OF NEKTONIC ANIMALS [O SOZDANII TELOM NEKTONNYKH ZHIVOTNYKH VERTIKAL'NYKH POPERECHNYKH SIL]

Yu. G. Aleyev *In its* Bionics Res. 20 Dec. 1966 p 33–39 refs (See N67-34501 20-04)

Transverse supportive or depressive forces produced by body shape of nektons is treated with regard to fishes, whales, dolphins, and sea turtles. It is demonstrated that body shape adjusts to the magnitude and sign of the buoyancy of the nekton. Author

N67-34505# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STREAMLINING CHARACTERISTICS IN CALAMARIES [OSOBENNOSTI OBTEKANIYA U KAL'MAROV]

F. V. Zuyev *In its* Bionics Res. 20 Dec. 1966 p 40–45 refs (See N67-34501 20-04)

Observations of calamaries made aboard the expeditionary vessel "Academician Kovaleskiy" in tropic and sub-tropic regions of the Pacific are discussed. It is concluded that streamlining of the calamary's body varies greatly during reactive movement, approaching the ideal during thrusts and worsening considerably when the mantle cavity is filled with water. It is noted that flow-by conditions of calamaries are nonstationary and are regulated by controlling the boundary layer. Author

N67-34506# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN MECHANICAL PROPERTIES OF THE TUBULAR BONES OF ANIMALS [NEKOTORYYE MEKHANICHESKIYE SVOYSTVA TRUBCHATYKH KOSTEY ZHIVOTNYKH]

K. P. Mel'nik and N. F. Voronkin *In its* Bionics Res. 20 Dec. 1966 p 48–53 refs (See N67-34501 20-04)

The ultimate compressive strength of bony tissue averages 20–30 kgs/mm^2 and depends on the position of the element in the extremity and the character of the load it bears. There is a direct relationship between the specific gravity of bone and its compressive strength. The strength of compacted material varies more along the perimeter of a bone than along its length. The greatest strength is usually observed in the dorsal wall of tubular bones. Bone specimens failed under the action of tangential stresses when compression-tested, forming cracks in inclined and longitudinal planes. Investigation showed the expediency of further study of the mechanical properties of bone in order to elucidate its "technological" characteristics and gain an understanding of its high reliability, which is manifested in the very complex and vitally important support and locomotor functions that it serves in the organism. Author

N67-34507# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN PHYSICOCHEMICAL AND MECHANICAL PROPERTIES OF THE SYNOVIA AND ITS ROLE IN THE MECHANISM OF THE EXTREMITAL JOINTS [O NEKOTORYKH FIZIKO-KHIMICHESKIKH I MEKHANICHESKIKH SVOYSTVAKH SINOVII I YEYE POLI V MEKHANIZME SUSTAVOV KONECHNOSTEY]

A. G. Berezkin *In its Bionics Res. 20 Dec. 1966 p 54–62* refs (See N67-34501 20-04)

The amount, specific gravity, viscosity, and total protein content of the synovia in the extremital joints of mammals are not constant, varying within substantial limits. The joints of the hind legs generally contain more synovia than the homodynamic joints of the front legs. The viscosity of the synovia depends both on its total protein content and on the content of its other components (mucins, mineral substances, etc.). The average total protein content of the synovia does not exceed 3.8. One of the most important functions of the synovial fluid is apparently its mechanical role as a shock absorber and a device for inhibiting the extreme phases of sharp movements. Author

N67-34508# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MORPHOFUNCTIONAL ANALYSIS OF THE BRACHIAL MUSCLES OF CERTAIN UNGULATES [K VOPROSU O MORFOFUNKTSIONAL'NOM ANALIZE MYSHTS PREDPLECH'YA NEKOTORYKH KOPTYNYKH]

A. D. Begeka *In its Bionics Res. 20 Dec. 1966 p 63–73* refs (See N67-34501 20-04)

The brachial flexors had a higher weight, volume, and length than the extensors in all the fast-moving ungulates investigated. The average length of the bellies of the brachial extensors was less than that of their tendons, the situation being reversed for the flexors. The specific gravity of the muscles studied was somewhat higher in the solipeds than in the artiodactyls. In addition to the differences between the two groups of ungulates, there were also more or less pronounced specific differences in all the indices. Author

N67-34509# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A MATHEMATICAL MODEL OF THE EXCITATION OF NERVE TISSUE [MATEMATICHESKAYA MODEL' VOZBUZHDENIYA NERVNOY TKANI]

Yu. G. Antomonov *In its Bionics Res. 20 Dec. 1966 p174–81* refs (See N67-34501 20-04)

Considered are the various energy relationships which may take place during excitation of nerve tissue in an attempt to construct the simplest mathematical model for excitation which

would simultaneously reflect many of the properties of nerve tissue. Formulas are given for the energy of the electrical excitation in terms of the power and voltage of the stimulating current and the resistance of the nerve tissue, and the possible reaction of the nerve tissue and response to electrical stimulation are analyzed. An integral equation is derived for the energy balance of nerve tissue during electrical stimulation. A formula is derived for the action potential assuming that the rate of passive change in the potential of nerve tissue is proportional to the applied voltage and decreases with an increase in potential. It is further assumed that the electrical properties depend on energy balance. An analog computer was used for analyzing the final equations, which were found to reflect the known physiological properties. Author

N67-34510# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF THE PROPERTIES OF A MATHEMATICAL MODEL OF THE EXCITATION OF NERVE TISSUE WITH A CONTINUOUS-ACTION COMPUTER [ISSLEDOVANIYE SVOYSTV MATEMATICHESKOY MODELI VOZBUZHDENIYA NERVNOY TKANI NA VYCHISLITEL'NOY MASHINE NEPRERYVNOGO DEYSTVIYA]

A. B. Kotova, L. I. Tushenkov, and Yu. G. Antomonov *In its* Bionics Res. 20 Dec. 1966 p 82–92 refs (See N67-34501 20-04)

An analog computer is used for analyzing a nonlinear nonhomogeneous differential equation with a discontinuity coefficient of the form: $U'+sgnW\cdot aU = V$; $W=E_n-\int V-V_n+V')dt+\int(U+U')dt$, where V is the stimulating voltage, U is the nerve tissue potential, E_n is the analog of the threshold value for the integral of external energy, and V_n is the threshold with respect to voltage. This model was analyzed for the following properties of nerve tissue switching function (2): (1) the nature of responses to subthreshold depolarizing and hyperpolarizing stimulation; (2) the threshold relationship for various forms of the stimulating pulse; (3) the threshold summation; (4) adaptation; (5) transformation of response rhythm; (6) response frequency as a function of the amplitude of a depolarizing stimulating pulse. A diagram is given of the model which was set up on an MN-7 nonlinear analog computer. Passive variations in the rest potential of the tissue (electronus) generated by weak pulses are discussed. Oscillograms and graphs are given. A comparison of these results with experimental physiological data shows that differential equation (1) and switching function (2) give a satisfactorily complete description of nerve tissue excitation. Author

N67-34511# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ELECTRIC MODELING OF BOND OSCILLATIONS IN NUCLEIC ACID AND DETERMINATION OF NUCLEOTIDE SEQUENCE [ELEKTRICHESKOYE MODELIROVANIYE SVYAZANNYKH KOLEBANIY V NUKLEINOVOY KISLOTE I PROBLEMA OPREDELENIYA POSLEDOVATEL'NOSTI NUKLEOTIDOV]

V. Ya. Maleyev, I. N. Todorov, and V. A. Kashpur *In its* Bionics Res. 20 Dec. 1966 p 93–104 refs (See N67-34501 20-04)

The theoretical possibility is considered of determining the nucleotide sequence in a nucleic acid from its vibrational spectrum. A mechanical model of a polynucleotide is proposed as a first approximation in which the polymer is linear with the least rigid bonds between the separate monomers (nucleotides). This model reflects several of the properties of the primary structure in nucleic acids. Associated vibrations are analyzed in a linear chain of n rigid nucleotides with masses M, $m_1,\ldots,m_{n-1}$ connected by uniform elastic threads of rigidity k. Longitudinal oscillations are considered in which the displacement vectors of all masses are parallel to the axis of the molecule. The frequencies of oscillations in this system are assumed to be known and an electrical analog of the model is used for demonstrating how these data may be used for determining the monomer sequence. The method is applied to an electrical polymer model consisting of a nonuniform LC ladder network. The results show complete agreement with the known sequence of monomers in nucleic acid chains. Author

N67-34512# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A FREQUENCY METHOD FOR INVESTIGATING INFORMATION TRANSMISSION THROUGH THE CEREBRAL SYNAPSES [CHASTOTNYY METOD ISSLEDOVANIYA PEREDACHI INFORMATSII CHEREZ SINAPTICHESKIYE SOYEDINENIYA MOZGA]

B. Ya. Pyatigorskiy *In its Bionics Res. 20 Dec. 1966 p 105–116* refs (See N67-34501 20-04)

The electrical model of the receptor neuron-transmitter neuron was made up of a pulsed element and pulse amplifier connected in series. Experimental data were obtained by electrical stimulation of the afferent fibers which make up the muscular nerves of the lower extremity in a cat. These data consisted of the responses of 40 transmitting cells. It is found that the system in the brain which transmits information on mechanical processes in the muscles is a linear pulsed amplifier at the level of the second link. The complex transfer constant for this link is equal to unity. This link differs considerably from the other links in synaptic transmission. Due to broad convergence, the second neurons in the system for skin sensitivity respond to a single input pulse with grouped discharge. The number of pulses in this discharge depends both on the prf at the input and on the rate at which this frequency changes. This indicates that the transfer function for the second link in this system is more complex in form. The proposed method and the equipment may be used for studying other links in the central nervous system. Author

N67-34515 Air Canada, Montreal (Quebec).

AIR CANADA REPORTED BIRD STRIKES/INCIDENTS, 1 JANUARY–31 AUGUST 1966

W. H. S. Bird 15 Sep. 1966 20 p

CFSTI: HC $3.00

Tabular data on incidents of bird collisions with various type Canadian civil aircraft in the vicinity of Canadian airports are presented. Details included are flight regime at time of incident, area of aircraft affected, bird species involved, and estimates of damage incurred. Comparisons of previously collected data are made. E.C.

N67-34537 Joint Publications Research Service, Washington, D. C.

BIOLOGICAL PROBLEMS STUDIED BY "VITYAZ" RESEARCH VESSEL

L. A. Zenkevich 26 May 1967 26 p Transl. into ENGLISH from Priroda (Moscow), no. 2, Feb. 1967 p 14–26 (JPRS-41170; TT-67-31811) CFSTI: $3.00

The marine investigations in the fields of microbiology, primary productions, plankton, bottom fauna, icthyology, and biochemistry are reviewed. The oceanic area selected was the Kurile–Kamchatka depression, and the lower bathyal, abyssal, and ultra-abyssal zones were emphasized. The sizes, numbers, and daily and seasonal migrations of plankton, bottom fauna, and fish are mentioned. Determinations of chlorophyll and other pigments are briefly discussed. N.E.N.

N67-34589*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

DESIGN AND EVALUATION OF CHEMICALLY SYNTHESIZED FOOD FOR LONG SPACE MISSIONS

Jacob Shapira *In its* The Closed Life-Support System 1967 p 175–187 refs (See N67-34583 20-05)

In application to providing food for astronauts by a regenerative diet from metabolic products, the literature is surveyed on synthetic methods adapted to the production of edible carbohydrates and fats in the space environment. The selection of carbohydrate and fat for study was dictated by the fact that they serve as the major source of calories in the normal diet. It is possible that less than 10% of the total food requirements of the astronaut would have to be carried along and would supply only those components of the diet that are difficult to synthesize, such as essential amino acids, unsaturated fatty acids, and vitamins. General considerations are provided on the condensation of formaldehyde, trioses and tetroses, continuous synthesis of formose mixtures, metabolic utilization of formaldehyde condensates, and the synthesis of fatty acids. R.L.I.

N67-34590*# Miami Univ., Coral Gables, Fla. Inst. of Molecular Evolution.

PROSPECTUS FOR CHEMICAL SYNTHESIS OF PROTEINACEOUS FOODSTUFFS

Sidney W. Fox *In* NASA. Ames Res. Center The Closed Life-Support System 1967 p 189–200 refs (See N67-34583 20-05)

(Grant NsG-689)

Some of the gaps in the research to be filled by a chemical investigation of proteinaceous foodstuffs are reported. Favorable aspects of knowledge from studies of molecular evolution are indicated, particularly the rationale of pansynthetic approaches. Some results of pansyntheses are mentioned. Consideration is given to the chemical synthesis of vitamins and the fact that they are obtained more economically by chemical synthesis than by isolation from biological material. R.L.I.

N67-34592*# School of Aerospace Medicine, Brooks AFB, Tex.

ALGAL SYSTEMS FOR BIOLOGICAL FOOD SYNTHESIS

C. H. Ward (Rice Univ.) and R. L. Miller *In* NASA. Ames Res. Center The Closed Life-Support System 1967 p 213–224 refs (See N67-34583 20-05)

In application to regenerative life support systems for long space missions, summary information is presented on factors known to affect the mass culture of algae (principally chlorellas) for photosynthetic gas exchange. The factors limiting algal growth, such as the transfer of energy in the form of light and the consequences of light saturation, are outlined. Tabular data are presented on a comparative analysis of photosynthetic gas exchange systems. A brief description is given of an experimental program to illustrate the immediate future of bioregeneration by photosynthetic processes. Photosynthesis as a means of bioregenerative life support is still considered an active area of research. R.L.I.

N67-34702*# Harvard Univ., Boston, Mass. Thorndike Memorial Lab.

A STUDY OF PHYSIOLOGICAL MECHANISMS AND INTER-RELATIONS BETWEEN SYSTEMIC AND REGIONAL BLOOD VOLUME, BLOOD FLOW AND ELECTROLYTE BALANCE Interim Progress Report

Walter H. Abelmann and Laurence E. Earley 30 Jun. 1967 8 p refs

(Grant NsG-595)

(NASA-CR-65675) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Studies on the interrelationship between renal hemodynamics and sodium and water balance in a dog were continued. The role of atrial size and function in the regulation of sodium excretion in human patients was also investigated. Preliminary evidence indicates that the sodium retaining effect of atrial fibrillation in intact man cannot be separated from the decrease in cardiac output and renal blood flow associated with arrhythmia. The role of ventricular filling pressure and circulating blood volume in determining the increased orthostatic tolerance in patients having heart disease and positioned in an upright tilt, was also investigated. The hemodynamic effects of oral phosphate supplements to patients with Paget's disease of bone were studied, and data suggest that the supplements favorably affect the abnormal cardiovascular dynamics of the disease and promote calcium retention in this disorder. L.S.

N67-34711 Bhabha Atomic Research Centre, Bombay (India). Air Monitoring Section.

CESIUM-127 AND POTASSIUM IN MILK

U. C. Mishra, A. S. Deshpande, R. Kerala Varma, and Kum. P. G. Kamath 1967 25 p refs

(BARC-278)

Cesium-137 and potassium results for milk samples from Bombay and other stations in India and from Gangtok (Sikkim State) are presented. These results are for the samples analysed after December 1960. Some of the interesting results are (a) highest value for Bombay milk during July 1963 (46.5 uuc Cs-137/gm potassium) (b) highest value of Cs-137 recorded in this laboratory for Gangtok (Sikkim State) during 1963 and (c) higher levels of Cs-137 during 1963 for all the stations, in general. Results for Bombay and Anand milk have been discussed in detail. No definite correlation between Cs-137 levels and rainfall has been observed for countrywide samples. The results do not show any definite latitude variation as well. The ratio of Cs-137 (uuc)/gm of potassium to Sr-90 (uuc)/gm of calcium has been briefly discussed for Bombay and Anand samples. Results for powder milk samples analysed are also given and briefly discussed. Author

N67-34723* Tufts Univ., Boston, Mass. Medical School.

[INVESTIGATION OF ATRAUMATIO TECHNIQUES FOR MONITORING CARDIO-VASCULAR CONDITIONING] Annual Report

David H. Spodick 17 Jul. 1967 12 p

(Grant NGR-22-012-006)

(NASA-CR-87800) CSCL 06P

Presented are results of an evaluation of external traumatic methods which were used to calculate the following indices of cardiovascular functions in cardiovascular-normal men in the age range 22 to 35 years: (1) left ventricular ejection period (LVET); (2) left ventricular isovolumetric contraction period (IVCT); (3) electromechanical lag (electromechanical interval (EMI)); (4) tension period; (5) isometric relaxation period; and (6) the rapid filling period. In studies of the left ventricular ejection period, an optimum method was established which was in agreement with both the indirect and direct measurements by other groups. In several of the other indices, notably the isovolumetric contraction period, widely conflicting reports based on different methods of measurement were extant. Papers which have been written or are in the process of being written are also cited. S.C.W.

N67-34731 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (West Germany). Institut fuer Flugmedizin.

HEMATOLOGIC AND BIOCHEMICAL STUDIES AFTER SHOCK WAVE INJURIES OF MINIATURE SWINES [HAEMATOLOGISCHE UND BIOCHEMISCHE UNTERSUCHUNGEN NACH DRUCKSTOSSVERLETZUNGEN VON ZWERGSCHWEINEN]

O. Wuensche and G. Scheele Jul. 1967 37 p refs In GERMAN; ENGLISH summary

(DLR-FB-67-42; DVL-657)

The hematologic and biochemical studies executed on a new species of test animals (miniature swine) serve for the investigation of unknown normal physiological values and their

variations after the effects of shock waves in an observation period up to 30 days after the explosion. The numerous pictures and tables show the results of the studies of the hemoglobin content, the osmotic resistance of the blood cells, the hematocrit values, the rate of blood sedimentation and the photometrically conducted analyses of the plasma constituents glucose, total cholesterin, esterified fatty acids, carbamide-nitrogen, chlorides and calcium. The effects of the shock wave on the humoral and corpuscular blood plasma constituents are discussed in detail. Author

N67-34791* Pennsylvania State Univ., University Park. Dept. of Biophysics.

PHYSICS OF CELLULAR SYNTHESIS, GROWTH AND DIVISION Status Report, 1 Jan.–30 Jun. 1967

E. C. Pollard Aug. 1967 17 p refs

(Grant NsG-324)

(NASA-CR-87813) CSCL 06C

Summaries of research projects in biophysics are presented. The addition of a mammalian cell program is reported. Progress in mutation studies is emphasized, particularly the ability to characterize the different mutagens. Other summaries include, the following areas of investigations: (1) pressure effects on bacteria and components of bacteria, (2) technique of whole-cell density gradient sedimentation, (3) lifetime of messenger RNA and transcription rate of the enzyme tryptophanase, (4) radiation of DNA viruses, (5) mutation and reversion, (6) electron spin resonance in irradiated pyrimidines and purines, (7) microspectrophotometry of human red cell membrane, and (8) gamma irradiation of calf thymus DNA at cryogenic temperatures. N.E.N.

N67-34813* Arde-Portland, Inc., Paramus, N. J.

CHEMICAL METHOD OF URINE VOLUME MEASUREMENT Final Report, 17 Dec. 1964–Jun. 1967

Paul Petrack Jun. 1967 256 p refs

(Contract NAS9-3904)

(NASA-CR-65682; Rept.-8642-FR) CSCL 06S

A system was developed and qualified as flight hardware for the measurement of micturition volumes voided by crewmen during Gemini missions. This chemical urine volume measurement system is used for obtaining samples of each micturition for post-flight volume determination and laboratory analysis for chemical constituents of physiological interest. The urine sample is used for the measurement of total micturition volume by a tracer dilution technique, in which tritiated water is introduced and mixed into the voided urine, and the resulting concentration of the tracer in the sample is determined with a liquid scintillation spectrometer. Results of testing demonstrated system volume measurement accuracy within the specification limits of ±5%, and operating reliability suitable for system use onboard the GT-7 mission. Author

N67-34821# Joint Publications Research Service, Washington, D. C.

CONTROLLED BIOSYNTHESIS

N. D. Iyerusalimskiy and B. G. Kovrov, ed. 24 May 1967 53 p refs Transl. into ENGLISH from the book "Upravlyayemyy Biosintez" Moscow, Izd. Nauka, 1966 p 5–19, 61–68, 258–262, 324–330, 362–366

(JPRS-41143; TT-67-31784) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. PRINCIPLES OF CONTROLLING MICROORGANISM GROWTH RATE N. D. Iyerusalimskiy p 2–17 refs (See N67-34822 20-04)

2. THE PROSPECTS OF MASS CULTIVATION OF ALGAE TO OBTAIN FODDER BIOMASS V. A. Kordyum p 18–26 refs (See N67-34823 20-04)

3. PROSPECTS OF USING UNICELLULAR ALGAL MUTANTS UNDER CONTROLLED CULTURING CONDITIONS K. V. Kvitko p 27–31 refs (See N67-34824 20-04)

4. A DEVICE FOR CONTROLLED FLOW CULTIVATION OF ALGAE WITH AUTOMATIC MEASUREMENT, RECORDING, AND REGULATION OF SUSPENSION DENSITY L. N. Tsoglin, V. Ye. Semenenko, F. M. Bochchar, and Yu. N. Filippovskiy p 32–39 refs (See N67-34825 20-04)

5. SIMPLE CONTROLLED NUTRIENT SUPPLY IN CONTINUOUS CULTIVATION OF FODDER YEASTS M. Ya. Kalyuzhnyy and Z. A. Boborako p 40–45 refs (See N67-34826 20-04)

N67-34822# Joint Publications Research Service, Washington, D. C.

PRINCIPLES OF CONTROLLING MICROORGANISM GROWTH RATE

N. D. Iyerusalimskiy *In its* Controlled Biosynthesis 24 May 1967 p 2–17 refs (See N67-34821 20-04)

Reproduction, metabolism, control of growth rate, and other life processes are briefly discussed in relation to a conference on Controlled Biosynthesis and Population Biophysics held on 26 June to 6 July 1965 in Krasnoyarsk. A diagram provides pertinent information on different types of continuous flow culturing, such as tubular method, homogeneously continuous method, battery method, and initial and ultimate concentration of nutrient substrate. Also mentioned is the influence of lactate concentration on specific growth rate of propionic acid bacteria. R.U.

N67-34823# Joint Publications Research Service, Washington, D. C.

THE PROSPECTS OF MASS CULTIVATION OF ALGAE TO OBTAIN FODDER BIOMASS

V. A. Kordyum *In its* Controlled Biosynthesis 24 May 1967 p 18–26 refs (See N67-34821 20-04)

The laboratory and industrial cultivation of unicellular algae is reviewed, in the light of fundamentally fallacious theory and practice of historical origin. The economic interest is in the capability of algae (*Chlorella*) to double their biomass every three hours. Further research is recommended to discover improved strains. R.U.

N67-34824# Joint Publications Research Service, Washington, D. C.

PROSPECTS OF USING UNICELLULAR ALGAL MUTANTS UNDER CONTROLLED CULTURING CONDITIONS

K. V. Kvitkox *In its* Controlled Biosynthesis 24 May 1967 p 27–31 (See N67-34822 20-04)

Effort is directed toward formulating a working hypothesis to explain the distinction between natural strains of an organism's cells. In the task of increasing the number of sulfur-containing amino acids in *Chlorella* biomass, techniques were developed for the rapid determination of cysteine and methionine content in the algae biomass: biochemical quantitative, microbiological quantitative, and microbiological qualitative. Mutants are considered promising for development of strains of unicellular algae with high productivity under controlled culturing conditions. R.U.

N67-34826# Joint Publications Research Service, Washington, D. C.

SIMPLE CONTROLLED NUTRIENT SUPPLY IN CONTINUOUS CULTIVATION OF FODDER YEASTS

M. Ya. Kalyuzhnyy and Y. A. Boborako *In its* Controlled Biosynthesis 24 May 1967 p 40–45 refs (See N67-34821 20-04)

Methodology and instrumentation for the continuous method of mass cultivation of microorganisms are examined briefly. This

method is being developed in two directions: cultivation of bacteria with removal of cells with medium, and cultivation with the return and multiple use of thickened culture. Present-day equipment for continuous cultivation consists of a cultivator or incubator of a simple design with special attachments to meter medium input, to maintain a constant culture volume and to estimate the density of its population, as well as to measure and control other parameters that maintain constant cultivation conditions for a series of generations. The medium metering device plays the leading role in controlling a continuous culture. R.U.

N67-34896 Joint Publications Research Service, Washington, D. C.

LIGHT SCATTERING IN THE STUDY OF BIOLOGICAL MACROMOLECULES

C. Ghita and E. Truta 13 Jul. 1967 20 p refs Transl. into ENGLISH from Fiziol. Norm. si Patol. (Bucharest), v. 11, no. 4, Jul.–Aug. 1965 p 333–345

(JPRS-41822; TT-67-32454) CFSTI: $3.00

The method and principle of light scattering, and the apparatus used are discussed. Some examples of its application in several proteins are presented to demonstrate the usefulness of the method in biophysical and biological research on macromolecules. Its essential advantage lies in the fact that the method combines simplicity of apparatus and measurements with a large amount of information. L.S.

N67-34914# Flying Personnel Research Committee, London (England).

THE EFFECT OF POSITIVE ACCELERATION UPON PULMONARY ARTERY PRESSURE IN MAN

D. H. Glaister and P. Howard Apr. 1966 19 p refs

(FPRC/1251) CFSTI: HC $3.00/MF $0.65

Pulmonary artery pressures have been measured in seated men during exposure to positive accelerations of up to 3 g. At 1 g, values obtained from 4 subjects averaged 17.2 cm water systolic and 4.3 cm water diastolic (12.5/3.2 mm Hg) with a mean of 9.5 cm water (7.0 mm Hg), referred to the level of the pulmonary trunk. Exposure to positive acceleration led to a fall in recorded pressures, a hydrostatic indifference point being demonstrated 8 cm below the pulmonary trunk. Results agreed well with predictions based upon previous measurements of pulmonary blood flow distribution, no evidence being found for a significant critical closing pressure in the pulmonary capillaries of the lung apex. Author

N67-34917* Oregon State Univ., Corvallis.

IDENTIFICATION OF CHILE ATACAMA DESERT SOIL ISOLANTS Progress Report

W. B. Bollen 6 Jun. 1967 13 p Prepared for JPL

(Contracts NAS7-100; JPL-950783)

(NASA-CR-87881) CFSTI: HC $3.00 CSCL 06M

Results of studies of 49 cultures containing Chile Atacama Desert soil isolants are reported. Of the 49 cultures, 32 failed to grow on transfer to media 1, 5, 6, thioglycollate slush agar, salt agar, or on trypticase soy agar. Of the remaining cultures, Streptomycetes, Bacillus, and mold species were identified. Descriptive charts containing data on staining, morphological, cultural, and physiological characteristics of the following bacteria are included: (1) *Bacillus subtilis* v. *aterrimus*; (2) *Bacillus brevis*; (3) *Bacillus cereus*; (4) *Bacillus subtilis*; and (5) *Micrococcus saseolyticus*. The medium used was trypticase soy agar. A summary table of overall results is also included. S.C.W.

N67-34924*# Illinois Univ., Urbana. Dept. of Physiology and Biophysics.

THE PHYSICAL AND CHEMICAL PROPERTIES OF HUMAN SWEAT AND FACTORS AFFECTING THE WATER BALANCE IN CONFINED SPACES Semiannual Report, 1 Jan.–30 Jun. 1967

Robert E. Johnson and Frederick Sargent 30 Jun. 1967 51 p refs

(Grant NGR-14-005-050)

(NASA-CR-87512; SAR-4) CSCL 06P

Progress is reported on a comprehensive study of the chemical and physical properties of human sweat produced by a combination of heat exposure and exercise on a motor driven treadmill. Efforts during this period were concerned with a comparison of the clearance ability of the sweat glands with that of the kidneys. The total solids of sweat are discussed and a comparison is made between the clearances of creatinine and urea by the kidney and by the sweat glands. The excretion of anions, cations, and other solutes in the sweat are examined and an attempt is made to generalize factors related to the excretion of solutes. The methods for chemical analysis and collection of sweat are briefly described. R.N.A.

N67-34933*# Sandia Corp., Albuquerque, N. Mex.

AN IMPROVED SONICATION METHOD FOR REMOVAL OF MICROORGANISMS FROM SURFACES

J. J. Mc Dade, C. M. Franklin (Lovelace Found.), F. W. Oswalt, and V. L. Dugan Jun. 1967 26 p ref

(NASA Order R-09-019-040)

(NASA-CR-87429; SC-RR-67-492) CFSTI: HC $3.00/MF $0.65 CSCL 06T

The approaches, efforts, and results to improve the technique of removing microorganisms from stainless steel strip surfaces by use of ultrasonic cavitation are described. Recommendations are made to enable others performing these operations to effect a more efficient removal in less time. Author

N67-34949*# Sandia Corp., Albuquerque, N. Mex.

THE MICROBIAL PROFILE OF A VERTICAL LAMINAR AIRFLOW SURGICAL THEATER

J. J. Mc Dade, J. G. Whitcomb, E. W. Rypka, C. M. Franklin (Lovelace Found.) and W. J. Whitfield Jun. 1967 31 p refs

(NASA Order R-09-019-040)

(NASA-CR-87428; SC-RR-67-456) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Quantitative and qualitative microbiological study conducted in a vertical laminar airflow surgical theater is described. Air samples were collected within the room and also directly at the incision. The levels of airborne viable particles that were detected and the types of microorganisms that were isolated are described. Data for a similar study in a conventional surgical theater are also presented. Results indicate that the laminar airflow surgical theater has a very low level of airborne microbial contamination, especially at the wound site. Higher levels of airborne viable contamination were detected in the conventional surgical theater. Author

N67-34951*# Oak Ridge National Lab., Tenn.

TISSUE CURRENT-TO-DOSE CONVERSION FACTORS FOR NEUTRONS WITH ENERGIES FROM 0.5 TO 60 MeV

D. C. Irving, R. G. Alsmiller, Jr., and H. S. Moran Aug. 1967 90 p refs

(NASA Order R-104; Contract W-7405-ENG-26)

(NASA-CR-87480; ORNL-4032; ORNL-TM-1522)CFSTI: HC $3.00/MF $0.65 CSCL 06R

To assist in the evaluation of the hazard associated with exposure to high-energy neutrons, a Monte Carlo computer program was used to calculate the energy deposition as a function of

depth in a 30-cm-thick infinite slab of tissue resulting from neutrons incident on the slab at energies up to 60 MeV. The program treated nonelastic and elastic interactions, including evaporation processes and nuclear recoils. Cases of both normal and isotropic incidence were calculated for neutrons of 0.5, 2, 10, 18, 30, and 60 MeV. From these data, current-to-dose conversion factors were extracted for the average whole-body dose, the dose at a 5-cm depth, and the maximum dose. A set of quality factors (QF's) was adopted for transforming rad dose to rem dose, but detailed energy deposition data are also presented so that any preferred set of QF's can be used to obtain estimates of the rem dose. Author

N67-35124*# Baylor Univ., Houston, Tex. Coll. of Medicine.
[STUDIES OF LIVER AND GASTROINTESTINAL TRACT IRRADIATED WITH PROTONS] Progress Report
1967 24 p refs
(Grant NGR-44-003-018)
(NASA-CR-87513) CFSTI: HC $3.00/MF $0.65 CSCL 06R

Electron microscopic studies were continued of granular cells present in jejunal epithelium as early as 6 hours following whole body irradiation with 138 MeV protons. The granules contain remnants of nuclei and cytoplasm which are presumed to be in various stages of degeneration because of the varying vestiges of recognizable ultrastructure remaining in these sequestered cellular components. Tentative findings suggest that epithelial cells can undergo various degrees of degeneration following irradiation; the severest form seems to be a large membrane bound sac of nuclear and cytoplasmic debris. The ultrastructure of hepatic tissue from Rhesus monkeys that were killed at 6, 12, and 18 hours after whole body irradiation with 2.3 BeV protons was studied. Tissue changes noted at each time interval are described. An analysis of mitochondria from liver cells irradiated with 32 MeV protons is briefly discussed. R.N.A.

N67-35163
OPERATION BIRD TRACK. ROOST MOVEMENT OBSERVATIONS IN METZ, FRANCE, AREA
P. P. Desfosses 23 Feb. 1967 9 p

Roost movements in the Metz, France, area tracked by radar during the spring and fall of 1965 indicate that hazardous conditions can be avoided by preventing low flying aircraft over roost areas between 02:30 and 05:30 GMT in the spring and between 05:00 and 07:00 GMT in the fall. Predictions for night flights are considered uncertain, although scattered movements of birds were observed between 15:30 and 18:30 GMT. M.W.R.

N67-35189# Florida Univ., Gainesville. College of Medicine.
FUNCTION OF MAMMALIAN RETINA DURING X-IRRADIATION Final Report, 1 Jun. 1965–1 Dec. 1966
William W. Dawson 29 Feb. 1967 33 p refs
(Contract DA-49-193-MD-2733)
(AD-653848) CFSTI: HC $3.00/MF $0.65

The electrical potentials elicited by light and low-dose X-irradiation were measured within the vitreous body of the eyes of rabbits. Nerve block agents and pharmacological degeneration of the visual receptors support the conclusion that although the eye is excited by X-rays the excitation does not occur at the site(s) responsible for light reception. The results are consistent with neural interaction effects, specifically, interactions with the lateral inhibitory system which encodes retinal information and increases the sharpness of figure-ground relationships. These findings are inconsistent with photopigment bleaching by X-rays which has been suggested as the basis for visual excitation by ionizing rays of all energies. Author (TAB)

N67-35193*# TRW Systems, Cape Canaveral, Fla.
A STUDY TO ASSESS THE IMPACT OF TOXIC PROPELLANTS ON KSC ECOLOGY Final Report
Dec. 1966 92 p refs Prepared in cooperation with Boyce Thompson Inst. for Plant Res., Inc., Yonkers, N. Y.
(Contract NAS10-3147)
(NASA-CR-87803) CFSTI: HC $3.00/MF $0.65 CSCL 06T

The impact of toxic propellants on plant species on and near John F. Kennedy Space Center is discussed. Nitrogen tetroxide which is currently used as an oxidizer, and hydrogen fluoride which would be the toxic vapor from a fluoride-based oxidizer, were the propellants studied. This study was concerned only with high vapor concentration, short duration exposures which might result from launch operations. The vapors of both propellants caused plant damage in proportion to the vapor concentration and exposure time. Boundary conditions for damage by NO_2 varied from 25 ppm for four hours to 250 ppm for 15 minutes. Boundary levels for HF ranged from 15 ppm for two hours to 8 ppm for four hours. HF was approximately 20 times more effective on a concentration basis than NO_2 in inducing plant damage. Plant damage induced by HF can be distinguished from that induced by NO_2 on the basis of the species affected, type of tissue injured, pattern of symptom development and expression, and chemical analyses. Injuries to plants observed in this study ranged from marginal effects through complete defoliation. The visible expressions of injury are described for a number of citrus varieties and ornamental species. Author

N67-35241# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
THE SEMINAR AT THE PHYSICS LABORATORY DURING THE PERIOD JANUARY–APRIL 1967 [IL SEMINARIO DEI LABORATORI DI FISICA NEL QUADRIMESTRE GENNAIO–APRILE 1967]
P. Guidoni et al 3 May 1967 39 p refs In ITALIAN; ENGLISH summary
(ISS-67/12)

Conference papers are presented on the seminar held at the Physics Laboratory, Rome, between January and April 1967. The topics include: the structure of circular DNA molecules; nuclear weapons; electron transitions in anisotropic crystals; magnetic waves in iron; genetic code; structure of nucleic acids in solution; irradiation of foodstuffs; macromolecular synthesis during *B.* subtilis sporulation; and elastic scattering of protons. Transl. by R.Ll.

N67-35264# Technische Hochschule Munchen (West Germany).
ON THE SIGNIFICANCE OF MITOCHONDRION FLAVIN ENYYME FOR THE REGULATION OF THE FERMENTATION SPEED THROUGH RESPIRATION ("PASTEUR EFFECT") [UEBER DIE BEDEUTUNG MITOCHONDRIALER FLAVIN-ENZYME FUER DIE REGULIERUNG DER GAERUNGSGESCHWINDIGKEIT DURCH DIE ATMUNG ("PASTEUR-EFFEKT")]
Juergen Schole (Ph.D. Thesis) 1966 41 p refs In GERMAN

Purpose of this study was to determine any possible correlation between the activity of mitochondrial flavin enzymes and the speed of fermentation, and to establish if flavin radicals on the mitochondria surface are responsible for such an effect. Of the compounds that were examined, all those that retard the Pasteur effect inhibit also particle-bound flavo proteids, particularly the L-amino acid oxidase and the butyryldehydrogenase. The activity of the glycerinaldehyde phosphatedehydrogenase (GAPDH), in the liver of a rat expressed in the DOAP/BTS quotient, depends linearly on the extent of the L-amino acid oxidation. Rat liver mitochondria react directly and without a latent period with the GAPDH. The activity increases at first in the presence of small mitochondria concentration, but it decreases below the initial value in the presence of high concentrations. Transl. by K.W.

N67-35286# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
MACROAGGREGATES OF TECHNETIUM-99M LABELED ALBUMIN [MACROAGREGADOS DE ALBUMINA MARCADOS CON TECHNECIO-99M]
T. de Paoli, A. Hager, J. O. Nicolini, and R. Radicella 1967 12 p refs In SPANISH; ENGLISH summary
(CNEA-193)

A preparation technique to obtain Tc-99m labeled human serum albumin macroaggregates for scintillation scanning of the lungs is described. Distribution tests carried out in laboratory animals demonstrate that, 30 minutes after the injection, more than 90% of the aggregates activity is retained by the lungs. Author

N67-35287 Nuclear Energy Information Center, Warsaw (Poland).
HYDROGEN—THE CARRIER OF LIFE—AN APPROACH TO ATOMIC BIOLOGY
Mieczyskaw Taube 1967 145 p refs *Its* Review Rept.-25

A theory is presented that five structural elements—X, Y, Z, Q, and R—are needed to build a living organism and that a suitable combination of these elements would yield the material carriers of the different functions of life. Corollaries pertaining to chemical elements as life carriers are assessed. The search for the five structural elements is conducted to identify the carriers of organization, the internal matrix, low entropy energy, and self-regulation; and the transporter of energy and information. It is concluded: (1) Hydrogen is the only element capable of providing the internal matrix. After hydrogen, oxygen plays the same role. (2) Hydrogen transport corresponds to energy transport. (3) The hydrogen bond is the responsible agent of the mechanism of self-regulation. (4) The transport of energy and structural information is affected by hydrogen bonds and covalent bonds, which combine hydrogen with oxygen, nitrogen, or carbon in the presence of phosphorus and, in some special cases, of sulfur. (5) All life in the universe is the outcome of chemical interaction between atoms of hydrogen, oxygen, carbon, nitrogen, phosphorus, and sulfur. M.G.J.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N67-34004*# Stanford Univ., Calif. Inst. for Mathematical Studies in the Social Sciences.
INFLUENCE OF CORRELATED VISUAL CUES ON AUDITORY SIGNAL DETECTION
R. C. Atkinson, J. Townsend, R. A. Kinchla (N. Y. Univ.), and J. I. Yellott, Jr. (Minn. Univ.) 2 Nov. 1965 26 p refs
(Grant NGR-05-020-036)
(NASA-CR-87408; TR-82) CFSTI: HC $3.00/MF $0.65 CSCL 05J

Two experiments investigated the effects on auditory signal detection of introducing visual cues that were partially correlated with the signal events. The results were analyzed in terms of a detection model that assumes that such cue-signal correlations will not affect sensitivity, but will instead cause the subject to develop separate response biases for each cue. The model specifies a functional relationship between the asymptotic values of these cue-contingent biases. The overall results of the experiments supported the detection assumptions of the model and the general bias learning assumption, but indicated a more complex learning process than that specified by the model. Author

N67-34007# George Washington Univ., Washington, D. C. Human Resources Research Office.
FACTORS INFLUENCING THE VISUAL DETECTION AND RECOGNITION OF LOW-ALTITUDE AIRCRAFT
A. D. Wright May 1967 13 p refs Presented at the Southwestern Psychological Assoc. Meeting, Arlington, Tex., 21–23 Apr. 1966 *Its* Professional Paper 20-67
(Contract DA-44-188-ARO-2)
(AD-654125) CFSTI: HC $3.00/MF $0.65

A study of mans ability to visually detect, recognize, and estimate range to low-altitude military aircraft is described. Twenty-seven Army enlisted men, who were given training and field experience in detecting and recognizing aircraft, served as observers. Observers were randomly assigned to the nine combinations of observer offset from the aircraft flight path (head-on, 650-, and 1,400-meter offset) and use of binoculars (binoculars for detection and recognition, binoculars for recognition, and no binoculars). Jet and propeller aircraft provided the low-altitude targets. Observers were provided early warning in time and aircraft position prior to each trial. Results of the study are presented. Author (TAB)

N67-34033*# Midwest Research Inst., Kansas City, Mo.
MEDICAL APPLICATIONS OF AEROSPACE SCIENCE AND TECHNOLOGY Quarterly Report, 1 May–31 Jul. 1967
David Bendersky 15 Aug. 1967 47 p refs
(Contract NASr-63(13); MRI Proj. 3077-E)
(NASA-CR-87407; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 06B

Brief resumes on applications of aerospace technology to nonaerospace biomedical problems are presented. Instrumentation, measuring apparatus, and techniques are covered. Medical problem abstracts and pertinent NASA tech briefs are included. N.E.N.

N67-34037# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Bad Godesberg (West Germany).
THE AEROBIC WORK CAPACITY OF UNTRAINED YOUNG MALES AND THEIR TOLERANCE TO SIMULATED ALTITUDE [DIE MAXIMAL AEROBE LEISTUNGSFAHIGKEIT UNTRAINIERTER JUNGER MANNER UND IHRE SAUERSTOFFMANGEL-BELASTUNGSTOLERANZ]
J. Eichhorn Jun. 1967 55 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-39; DVL-656)

In a comparative study of human performance under various stresses, the maximum oxygen uptake of 20 male college students, none of them active in sports, was measured during strenuous work and additionally predicted by the Astrand–Rhyming method and by the Performance Pulse Index method of Mueller. Also measured and evaluated was the tolerance to lowered atmospheric pressure. While a significant correlation was found to exist between the different methods of estimating the oxygen uptake, the relation between the maximum work effort and the hypoxic tolerance was negligible. K.W.

N67-34094# HRB-Singer, Inc., State College, Pa.
THE CORRECTION OF HELIUM SPEECH DISTORTION Final Report, May 1966–May 1967
R. S. Brubaker and J. W. Wurst May 1967 49 p refs
(Contract N00014-66-C-0228)
(Rept.-4007-F-1; AD-653471) CFSTI: HC $3.00/MF $0.65

A technique for removing the distortion inherent in speech uttered in a helium-rich atmosphere is the object of considerable research. The report describes an approach which corrects the formant frequencies and the vowel-consonant ratios, two factors which are the most affected by the helium environment. The correction process occurs in real time, the signal suffering less

than 10 milliseconds delay. Because the circuitry is largely digital, processor volume is estimated to be about 10 cubic inches after the first step toward microminiaturization is taken. Author (TAB)

N67-34103* Stanford Univ., Calif. Inst. of Mathematical Studies in the Social Sciences.
CHOICE BEHAVIOR IN A CUED-RECOGNITION TASK
James T. Townsend 8 Aug. 1966 127 p refs
(Grant NGR-05-020-036; Grant PHS MH-6154)
(NASA-CR-87398; TR-103) CFSTI: HC $3.00 CSCL 05J

A cued-recognition paradigm was used to investigate behavior in a psychophysical task that minimized the role of immediate memory but maximized discrimination behavior. A class of models that generates predictions for several characteristics of a subject's choice behavior was developed and applied to the receiver operating characteristics (ROC) data for each subject. Certain models appeared to provide an accurate description of the ROC results on a group and individual basis, according to an orthogonal regression measure of goodness of fit. The various special recognition–confusion models applied to the present data are tabulated. Particular recognition–confusion models are capable of yielding confidence-rating predictions that are in general agreement with the data. Estimates of the number of symbols processed by thr subjects compared favorably with earlier estimates in similar experiments, and these results are discussed with regard to other methods of studying the number of symbols apprehended in a brief interval. R.N.A.

N67-34108# Aerospace Medical Div. Arctic Aeromedical Lab., Fort Wainwright, Alaska.
AUXILIARY HEATED HANDWEAR FOR ARCTIC MAINTENANCE PERSONNEL Technical Report, Nov. 1964–Dec. 1965
John F. Roy Mar. 1967 13 p
(AAL-TR-67-1; AD-653532) CFSTI: HC $3.00/MF $0.65

Electrically heated gloves were developed to protect maintenance personnel in severe cold, allow manual dexterity and be powered by rechargeable lightweight batteries. Tests with such gloves to -45F disclosed that 15 watts per hand applied intermittently was sufficient to keep hands warm in the most severe conditions. Manual dexterity tests in the cold showed that for most tasks ordinarily performed by maintenance personnel, the electrically heated gloves used would still have to be removed. Because of this limitation and the high weight to power ratios of batteries currently available, it was determined that the practical value of systems that could be developed did not warrant further pursuit of auxiliary heated development at this time. Author (TAB)

N67-34113# Naval Radiological Defense Lab., San Francisco, Calif.
FEASIBILITY AND POTENTIAL EFFECTIVENESS OF PARTIAL-BODY SHIELDING FOR PERSONNEL PROTECTION AGAINST IONIZING RADIATION
Edwin S. Shapiro 11 Apr. 1967 66 p refs
(USNRDL-TR-67-39; AD-653459) CFSTI: HC $3.00/MF $0.65

The feasibility of partial-body shielding is discussed from two points of view. The first assumes that limited clinical and experimental data are extrapolable to the operational situations of interest and that it is possible to selectively protect against the neural, hemapoietic, and gastrointestinal components of the acute radiation syndrome. Under this assumption, it would appear that (a) neural syndrome symptomatology may be adequately controlled by means of drugs, (b) the hemapoietic syndrome may be controlled by a light-weight (under 10 lbs) lead epicondylar cuff, and (c) in many operational situations the gastrointinal syndrome may be controlled by an abdominal shield sufficiently light in weight to permit postattack personnel to efficiently perform their tasks. The second point of view discussed assumes that, at present, there is not an adequate basis for selective syndrome shielding, and that a metal shield covering all of the body from the hips to the neck is the only adequate form of protection. Under this assumption it would appear that weight limitations preclude the use of this type of shield in most situations in which personnel must enter the fallout field at specified times and remain until the completion of their mission. However, in the case of personnel who are not required to enter the field at any specified time and who may be recalled after receiving a predetermined dose, trunk shields of acceptable weights will significantly lower entry times and extend stay times. The use of a grid (sieve) trunk shield is discussed and it appears that a shield of this type, of acceptable weight, may be of benefit in many operational situations in which the solid shield was not. TAB

N67-34122*# Stanford Univ., Calif. Inst. for Mathematical Studies in the Social Sciences.
MODELS FOR OPTIMIZING THE LEARNING PROCESS
G. J. Groen and R. C. Atkinson 11 Feb. 1966 36 p refs
(Grant NGR-05-020-036; Contract OE-5-10-050)
(NASA-CR-87406; TR-92) CSCL 05J

Certain instructional problems are deformulated as problems in the mathematical theory of optimization. A common instructional paradigm is outlined and a notational system is proposed which allows the paradigm to be restated as a multi-stage decision process with an explicit mathematical learning model embedded within it. The notion of an optimal stimulus presentation strategy is introduced and some problems involved in determining such a strategy are discussed. A brief description of dynamic programming is used to illustrate how optimal strategies might be discovered in practical situations. Author

N67-34172# Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE EFFECT OF LUNAR GRAVITY ON MAN'S PERFORMANCE OF BASIC MAINTENANCE TASKS
Richard J. Shavelson and Joseph L. Seminara 1 Jun. 1967 39 p refs
(Rept.-6-77-96-0)

Nine subjects were trained extensively on three maintenance tasks: bolt torquing, connector mating, and nut threading. They were randomly distributed into one of three clothing conditions (shirt-sleeve, vented suit, and pressurized suit) and trained and tested on all three tasks in three gravity conditions (one gravity, one gravity in the harness, and one-sixth gravity). This study demonstrated that lunar gravity imposed a twenty-five-percent performance decrement over performance in one gravity ($p < .01$). The vented suit imposed a sixty-percent performance decrement ($p < .01$) and the pressurized suit imposed a 150-percent performance decrement ($p < .01$) when compared to performance in the shirt sleeve mode. On the basis of these findings and subjective reports, preliminary human factors design criteria were suggested for lunar gravity performance aids. The need for subsequent research in the areas of mission-specific maintenance tasks and candidate job aids to improve performance in the lunar environment was pointed out. Author

N67-34195# Aerospace Medical Div. Personnel Research Lab. (6570th), Lackland AFB, Tex.
DESCRIBING AIRMAN PERFORMANCE IN THE ADMINISTRATIVE CAREER LADDER BY IDENTIFYING PATTERNS OF TRAIT RATINGS
Llewellyn N. Wiley Nov. 1966 56 p refs
(PRL-TR-66-13; AD-653544) CFSTI: HC $3.00/MF $0.65

Trait ratings were used to account for the variance in airman performance reports and in overall experimental performance ratings. Airmen in the administrative career ladder, DAFSCs 70230, 50, 70, and 70490, across all commands, were rated by supervisors on overall performance and on 65 traits. Current overall airman performance reports (APRs) were obtained from base records. Among the 2,606 sets of ratings with complete data, 1,083 individuals were evaluated twice, representing personnel rated by two supervisors. Broken down by skill levels, the smallest N was 140, for 9-level men who had been rated twice. Using data undifferentiated by skill, in which a man might appear twice if so rated, trait ratings accounted for 70 per cent of the variance in experimental performance ratings and about 43 per cent of the variance in APRs, after grade was removed as a predictor. When data were sorted by skill level, prediction held up in all skills except DAFSC 70270, where it dropped to 60 per cent. Patterns of traits which were more predictive of performance in one skill level than another were found, and these patterns could be sensibly interpreted in terms of the expected demands of the jobs. In a cross-validation against different raters, the predictive advantage of selected patterns was found to be statistically significant for the 5-, 7-, and 9-skill levels. The study is discussed in terms of its implications for criterion development, particularly in respect to its place in the sequence of current criterion research studies. Author (TAB)

N67-34210# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.

A TECHNIQUE FOR DETERMINING AN INDEX OF VISUAL ALERTNESS FROM THE ELECTROENCEPHALOGRAM

George E. Bergey, William C. Sipple, William A. Hamilton, and Russell D. Squires 23 May 1967 27 p refs

(NADC-MR-6618; AD-653451) CFSTI: HC $3.00/MF $0.65

A technique is described for evaluating the visual alertness of humans. This technique utilizes a transistorized EEG analyzer consisting of an automatic signal level control, a number of paralleled active bandpass filters, and a switching arrangement to allow modification of bandpass characteristics by the user. The output of the analyzer consists of four D.C. signals, the voltage of each being proportional to the EEG activity within the variable frequency bands selected by the experimenter. This evaluation of visual alertness involves monitoring these four analyzer outputs while the subject performs a routine designed to provide alpha suppression. Author (TAB)

N67-34237# Federal Aviation Agency, Washington, D. C. Aircraft Development Service.

EXPERIMENTAL ASSESSMENT OF GROUND TRAINERS IN GENERAL AVIATION PILOT TRAINING Final Report

Warren G. Crook Apr. 1967 36 p ref

(FAA-ADS-67-5; AD-652371) CFSTI: HC $3.00/MF $0.65

An evaluation was conducted to compare the effectiveness of different types of ground trainers when used in the private pilot flight training program. One objective was to determine standards for identifying ground trainers in which instruction would be acceptable toward pilot certification requirements. A second objective was to determine how much time in a trainer might be substituted for actual flight time. No specified design or operational standards for ground trainers is recommended. Results showed that average total airplane time to reach private pilot proficiency was reduced by 16%. A 15% substitution of trainer time for airplane instruction time is recommended in the approved 35-hour primary flight curriculum requirements. Author (TAB)

N67-34286*# Stanford Univ., Calif. Inst. for Mathematical Studies in the Social Studies.

RECALL OF PAIRED-ASSOCIATES AS A FUNCTION OF OVERT AND COVERT REHEARSAL PROCEDURES

John W. Brelsford, Jr. and Richard C. Atkinson 21 Jul. 1967 27 p refs

(Grant NGR-05-020-036)

(NASA-CR-87507; TR-115) CFSTI: HC $3.00/MF $0.65 CSCL 05J

The effect on memory of the mode of studying paired-associates was investigated using a continuous-presentation technique. Overt rehearsal was found to be superior to covert for all Ss. Furthermore, the form of the forgetting curve was qualitatively different for the two study procedures. The overt-rehearsal curve dropped slowly at first and then very rapidly defining an S-shaped function, whereas the curve for the covert-study condition decayed exponentially. A mathematical model employing a short-term rehearsal buffer and a long-term memory state accurately predicted the data obtained under the two study conditions. Author

N67-34338* TRW Systems, Redondo Beach, Calif.

THE THERMAL PROPERTIES OF SELECTED SPACE SUIT MATERIALS

Jerry T. Bevans 31 Oct. 1965 172 p refs

(Contract NAS9-3670)

(NASA-CR-65678; TRW-5318-6001-SU-000) CSCL 05E

Certain thermal properties of selected space suit components have been measured. These properties include the solar absorptance, total emittance, and solar transmittance of the appropriate materials; the effective thermal conductance of a sample of the space suit composite was also measured under steady state and transient conditions. Author

N67-34388# Goteborg Univ. (Sweden).

HUMAN PERFORMANCE AND BEHAVIOUR IN HYPERBARIC ENVIRONMENTS

John Adolfson Stockholm, Almqvist & Wiksell, 1967 74 p refs /*ts* Acta Psychologica Gothoburgensia, No. 6

Human performance and behavior in dry and wet hyperbaric environments, including ambient pressures of 13 atmospheres absolute was investigated in application to depth narcosis of divers. This hyperbaric intoxication, also known as nitrogen narcosis and rapture of the depths, has cost a number of divers' lives since the introduction of modern deep diving. The studies were performed in a compression chamber on 50 selected male naval personnel and trained divers. It was confirmed that motor performance becomes deteriorated in hyperbaric air and that the deterioration increases with the ambient pressure. The delayed responses in the hearing discrimination experiments and the association tests were explained as due to the influence of depth narcosis on the diver's consciousness and wakefulness. The observation that at raised air pressures the decrement in manual dexterity became enhanced during physical exercise was explained as being due to an elevation of the tissue CO_2 tension during exertion in hyperbaric air, assuming a synergistic narcotic action of high nitrogen and high carbon dioxide tensions. R.U.

N67-34432*# Stanford Univ., Calif. Inst. for Mathematical Studies in the Social Sciences.

SPELLING DRILLS USING A COMPUTER-ASSISTED INSTRUCTIONAL SYSTEM

Jack M. Knutson 30 Jun. 1967 81 p refs

(Grant NGR-05-020-036)

(NASA-CR-87482; TR-112) CFSTI: HC $3.00/MF $0.65 CSCL 05J

The feasibility of using computer-assisted drill and practice instruction as both a pedagogical and research tool was studied. Two main methods were followed: (1) The number and spacing of repetitions on error items were varied to determine the effects on learning of new spelling words in a drill context. (2) The effect

of student confidence estimates in the correctness of his response was investigated. Subjects were 42 culturally disadvantaged elementary school students. A modified digital computer with a variety of input and output devices was included in the instruction equipment. Word list selection, construction, administration, and grading procedures are described in detail. Response data are analyzed on an individual and group basis, and consideration is given to group differences and time and testing variables. Overall analysis indicates that repetition of error words generally led to greater learning. Confidence rating results tenuously suggest that confidence ratings and the probability of a correct response are related in an orderly, linear fashion. E.C.

N67-34496 Royal Aircraft Establishment, Farnborough (England). Inst. of Aviation Medicine.
FURTHER STUDIES UPON THE HUMAN ASPECTS OF FIRE IN ARTIFICIAL GAS ENVIRONMENTS
D. M. Denison and W. J. Tonkins Mar. 1967 30 p refs
(R-400)

Ignition tests were performed on denim overalls placed on a life-size brass dummy in an atmosphere of either pure oxygen at pressures from 50 to 750 mmHg, oxygen–nitrogen and oxygen–helium mixtures of varying concentrations at a pressure of 750 mmHg, and similar mixtures at pressures in the range 150 to 350 mmHg. Among effects considered were wear level and moisture content of the overalls, ignition time, proximity to the material Perspex, posture position and location of the ignition source on the dummy, and wind draft effects. Burning properties of human skin in air and in oxygen were also studied. Based on the findings, a table is constructed which indicates relative conditions in which manual responses would be unable to prevent ignition of clothing or 50% destruction of skin. E.C.

N67-34513# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ONE METHOD OF RECOGNIZING A LIMITED SET OF WORDS [OB ODNOM METODE RASPOZNAVANIYA OGRANICHENNOGO NABORA SLOV]
V. A. Dolyatovskiy *In its Bionics Res. 20 Dec. 1966 p 117–130* refs (See N67-34501 20-04)

The problem of recognizing speech signals is considered as a special case of pattern recognition. The physiology of the human auditory analyzer is discussed with regard to electrical potentials generated in various sections under acoustic stimulation. Speech signals were studied for constructing a speech recognition system. Phonemes and sets of words were studied including numbers pronounced by different speakers. Time characteristics of speech signals were used for determining the invariant features of individual words. It is shown how these data may be used to represent each word in digital form by quantization of amplitude and time. Numerical descriptions are given for the low frequency envelopes of a set of speech signals using five levels of quantization with respect to amplitude and ten moments of quantization with respect to time. These data, taken for speakers with various vocal characteristics, indicate that pattern recognition is possible since the numerical descriptions of the set differ. Briefly described is a device for decoding these numerical representations. Author

N67-34583*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE CLOSED LIFE-SUPPORT SYSTEM
Washington, NASA, 1967 231 p refs Proc. of the Conf. on the Closed Life-Support System, held at Moffett Field, Calif., 14–15 Apr. 1966
(NASA-SP-134) CFSTI: HC $3.00/MF $0.65 CSCL 06K

CONTENTS:

1. STUDY OF LIFE-SUPPORT SYSTEMS FOR SPACE MISSIONS EXCEEDING ONE YEAR IN DURATION G. L. Drake, C. D. King, W. A. Johnson, and E. A. Zuraw (Gen. Dyn./Convair) p 1–74 refs (See N67-34584 20-05)

2. STUDY OF LIFE SUPPORT SYSTEMS FOR SPACE MISSIONS EXCEEDING ONE YEAR IN DURATION R. B. Jagow and R. S. Thomas (Lockheed Missiles and Space Co.) p 75–143 refs (See N67-34585 20-05)

3. PLANS FOR A PROGRAM TO STUDY CLOSED LIFE-SUPPORT SYSTEMS E. G. Lyman p 145–149 (See N67-34586 20-05)

4. WASTE STABILIZATION IN SPACE ENVIRONMENTS H. G. Schwartz, Jr. and J. E. McKee (Calif. Inst. of Tech.) p 151–162 refs (See N67-34587 20-05)

5. THE SPIN-INERTIA CULTURE SYSTEM IN WASTE TREATMENT IN CLOSED SYSTEMS C. G. Golueke and W. J. Oswald (Calif. Univ.) p 163–174 refs (See N67-34588 20-05)

6. DESIGN AND EVALUATION OF CHEMICALLY SYNTHESIZED FOOD FOR LONG SPACE MISSIONS J. Shapiro p 175–187 refs (See N67-34589 20-04)

7. PROSPECTUS FOR CHEMICAL SYNTHESIS OF PROTEINACEOUS FOODSTUFFS S. W. Fox (Miami Univ.) p 189–200 refs (See N67-34590 20-04)

8. THE EFFECTS OF CONTROLLED ENVIRONMENT ON THE GROWTH OF HYDROGENOMONAS BACTERIA IN CONTINUOUS CULTURES J. F. Foster and J. H. Litchfield (Battelle Memorial Inst.) p 201–212 refs (See N67-34591 20-05)

9. ALGAL SYSTEMS FOR BIOLOGICAL FOOD SYNTHESIS C. H. Ward and R. L. Miller (School of Aerospace Medicine) p 213–224 refs (See N67-34592 20-04)

N67-34584*# General Dynamics/Convair, San Diego, Calif.
STUDY OF LIFE-SUPPORT SYSTEMS FOR SPACE MISSIONS EXCEEDING ONE YEAR IN DURATION
G. L. Drake, C. D. King, W. A. Johnson and E. A. Zuraw NASA, Ames Res. Center The Closed Life-Support System 1967 p 1–74 refs (See N67-34583 20-05)

Physiological considerations in a closed ecological system are discussed in relation to projected manned space missions of long duration, since for such a life support system it is essential to convert human and cabin waste products into useful products such as oxygen, food, and potable water. Emphasis was placed on this food-waste closure work while research on other life-support subsystems was directed primarily at insuring integration compatibility. Summarized are the accomplishments of the following tasks: state of development of life support subsystems; configurations of closed ecological systems; preferred systems selected, based on estimates of engineering and biological practicality; and requirements for research and development to qualify the systems for engineering design. R.U.

N67-34585*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
STUDY OF LIFE SUPPORT SYSTEMS FOR SPACE MISSIONS EXCEEDING ONE YEAR IN DURATION
R. B. Jagow and R. S. Thomas, ed. *In* NASA. Ames Res. Center The Closed Life-Support System 1967 p 75–143 refs (See N67-34583 20-05)
(Contract NAS2-3012)

The requirement for developing a regenerative life support system that minimizes the expendable materials aboard spacecraft during long manned flights is analyzed. Major program emphasis was placed on the establishment and comparison of candidate approaches to closed ecological systems in three categories: physicochemical systems with stored food, chemical synthesis of food, and biological systems. Considerable data are presented in support of: formaldehyde synthesis used as intermediate in forming edible polycarbon compounds; glycerol synthesis, phytosynthetic

organisms, aerobic digestion, the chromatographic approach to the resolution of racemic mixtures. Of all the physicochemical subsystems other than food synthesis subsystems examined, the greatest advantages were offered by the electro-dialysis and liquid absorption CO_2 removal subsystems, the Bosch and solid electrolyte cell CO_2 reduction subsystems, the porous electrode-absorbent matrix and ion exchange membrane water electrolysis cells, and the waste heat and thermoelectric vacuum waste water distillation units. R.U.

N67-34586*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PLANS FOR A PROGRAM TO STUDY CLOSED LIFE-SUPPORT SYSTEMS

E. Gene Lyman *In its* The Closed Life-Support System 1967 p 145–149 (See N67-34583 20-05)

The definition of configurations of closed ecological systems for manned spacecraft flights, and the plan to pursue systems engineering in such a life support system are presented. Developmental program effort is directed toward establishing breadboard configurations of certain key concepts that will be required in a first-generation, closed life-support system. Initial evaluation and screening of potential synthetic foodstuffs is mentioned. The continuation of analytical studies is reported on such factors as operation in a reduced gravity field, recovery of fuels or propellants from metabolic wastes. R.U.

N67-34587*# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Environmental Health Engineering.

WASTE STABILIZATION IN SPACE ENVIRONMENTS

H. G. Schwartz, Jr. and J. E. McKee *In* NASA. Ames Res. Center The Closed Life-Support System 1967 p 151–162 refs (See N67-34583 20-05)

A brief technical discussion is presented on one particular means of biological waste stabilization of possible value in an integrated system for waste management and water reuse during long manned spacecraft flights. Reviewed are some alternate methods of waste-water purification. A reasonable approach to water recovery systems involves an aerobic, biological process to stabilize the organic waste waters, followed by some type of physical and/or chemical technique to produce the final, high-quality drinking water. The ability of the intermittent sand filtration system to produce a stabilized effluent from space vehicle waste products is also considered. R.U.

N67-34588*# California Univ., Berkeley. Sanitary Engineering Research Lab.

THE SPIN-INERTIA CULTURE SYSTEM IN WASTE TREATMENT IN CLOSED SYSTEMS

Clarence G. Golueke and William J. Oswald *In* NASA. Ames Res. Center The Closed Life-Support System 1967 p 163–174 refs (See N67-34583 20-05)

The aerobic breakdown of waste products by bacteria and other microorganisms is considered in terms of applicability to long manned spacecraft flights. Laboratory research surveyed: the nature of those conditions under which the desired bacteria function most effectively; ways of maintaining dense cultures of the organisms under these conditions; methods of establishing required conditions; and methods to make oxygen available to the organisms in such a way that it does not limit their activities. Experience with the spin-inertia culture system of algarton furnish sound reasons for believing that it can be used to advantage in waste treatment of such closed ecological systems. R.U.

N67-34591*# Battelle Memorial Inst., Columbus, Ohio.

THE EFFECTS OF CONTROLLED ENVIRONMENT ON THE GROWTH OF HYDROGENOMONAS BACTERIA IN CONTINUOUS CULTURES

John F. Foster and John H. Litchfield *In* NASA. Ames Res. Center The Closed Life-Support System 1967 p 201–212 refs (See N67-34583 20-05)

Consideration is given to the three-step closed life support cycle to convert human metabolic wastes, urea and carbon dioxide, into breathable oxygen and a food supplement. Two steps of the cycle are described: (1) the collection and recovery of the CO_2 removed from the cabin atmosphere by a regenerable CO_2 absorber, so that relatively pure CO_2 gas can be fed into the gas phase of the continuous culture; and (2) the electrolysis of water to produce breathable oxygen for the cabin supply, and by-product hydrogen, which is also fed to the gas phase of the closed culture vessel. In developing a workable closed cycle, the primary objective is to control the environment of the continuous culture so as to maintain a steady state indefinitely, operating at the highest efficiency. A large number of variables to be controlled in a continuous culture of Hydrogenomonas eutrophy are described in a preliminary way. Further study in this area is indicated. R.U.

N67-34634# School of Aerospace Medicine, Brooks AFB, Tex.

VISUAL ILLUSIONS AND AIRCRAFT ACCIDENTS Final Report, Oct. 1964–Sep. 1965

Donald G. Pitts Apr. 1967 39 p refs

(SAM-TR-67-28; AD-653518) CFSTI: HC $3.00/MF $0.65

The visual system and vestibular system interact to form a complex relationship in certain flying situations which results in spatial disorientation. The severity of the problem depends on how the pilot decides to utilize sensory information to control the aircraft. A correct decision results in adequate control of the aircraft, whereas an incorrect decision may prove fatal. The autokinetic, oculogyral, oculogravic, and Coriolis illusions are discussed; proposed research is outlined; and recommendations are given for minimizing the effects of illusions on the pilot. Perspective and motion parallax afford the most consistent visual information from which the pilot formulates his judgement of distance. Distance perception is the result of an integration of all visual cues with past experience, and any change in glide slope, external terrain, aircraft speed, and awareness may result in significant distance judgment errors. Reduction in impinging external stimuli by darkness, inclement weather, and emotional stress factors greatly accentuate the pilots susceptibility to illusions. Thus, these conditions require special training and instrument discipline to insure safe flying approaches, and landings. Author (TAB)

N67-34681# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

SPEECH IN AN ARTIFICIAL ATMOSPHERE (44% OXYGEN–56% HELIUM) Final Report, Feb. 1965–Jul. 1966

Frank Trimboli (Dayton Univ. Res. Inst.), Charles W. Nixon, William E. Mabson, James E. Endicott (School of Aerospace Med.), and B. E. Welch Dec. 1966 29 p refs Prepared in cooperation with Dayton Univ. Res. Inst. and School of Aerospace Med.

(Contract AF 33(615)-1135)

(AMRL-TR-66-165; AD-653519) CFSTI: HC $3.00/MF $0.65

Intelligibility and physical characteristics of helium speech were investigated during a simulated space mission at Brooks Air Force Base, Texas. Speech was produced under conditions of room air at ground level, 100% oxygen at 18,000 feet, 56% helium-44% oxygen at 18,000 feet, and 80% helium-20% oxygen at ground level. Results of both objective and subjective analyses of the data show that (1) word intelligibility in the 80% helium condition was less than in room air, (2) when in the presence of noise, intelligibility was less in both 56% and 80% helium

mixtures than in room air, (3) the high fundamental pitch observed immediately upon entering the helium atmosphere gradually decreased, but did not return to the prehelium level of pitch, (4) measured rate of speaking was unaffected, and (5) mean second formant frequencies were 1.35 times higher in 56% helium and 1.62 times higher in 80% helium than in room air. Observed ratios were slightly less than ratios predicted on the basis of velocity of sound in the vocal tract. Author (TAB)

N67-34689*# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
HANDS-FREE, PRECISION CONTROL FOR EVA—AN EXPLORATORY STUDY
T. Keller, H. Breul, R. Weston, and J. O'Hagan Jan. 1967 42 p refs
(Contract NAS2-2595)
(NASA-CR-73105; RE-275) CSCL 05H

Extensive research into the use of the human foot-balancing reflex for control of vehicles in the one-g environment has led to an extrapolation of the concept to its use for extra vehicular activity (EVA), the maneuvering of free-floating spacemen. An exploratory program in which zero-gravity was simulated for three degrees of freedom in the horizontal plane has proved the basic utility of the idea and provided a model for the preliminary design of a prototype, EVA control system. Author

N67-34705* Clark (David) Co., Inc., Worcester, Mass.
PRESSURE SEALING CLOSURE Final Report, 15 Mar. 1963–28 Feb. 1966
28 Feb. 1966 83 p
(Contract NAS9-1186)
(NASA-CR-65686; R-1202) CSCL 06K

The research, development, and fabrication of the mechanically operated pressure sealing closure, for making self-donning and doffing of a space suit more practical, are summarized. Emphasis during the final phase was on the development of a ductile elastomer for forming the closure during fabrication to adapt to the configuration of the man, and on modifications in lead screw and restraints. It is concluded that the feasibility of the closure is confirmed. N.E.N.

N67-34714*# Stanford Univ., Calif. Inst. for Mathematical Studies in the Social Sciences.
SOME TWO-PROCESS MODELS FOR MEMORY
R. C. Atkinson and R. M. Shiffrin 30 Sep. 1966 24 p refs
Presented at the Symp. on Mathematical Models of Psychological Processes, 18th Intern. Congr. of Psychology, Moscow, Aug. 1966
(Grant NGR-05-020-036)
(NASA-CR-87446; TR-107) CFSTI: HC $3.00/MF $0.65 CSCL 05J

A general theoretical framework is developed in which to view memory and learning. The basic model is presented in terms of a memory system having two central components: a transient-memory buffer and a long-term store. Each stimulus item is postulated to enter a constant-sized push-down memory buffer, stay a variable amount of time, and leave on a probabilistic basis when displaced by succeeding inputs. During the period that each item resides in the buffer, copies of the item are placed in the long-term store. The remaining feature of the model is concerned with the recovery of items from the memory system at the time of test. If at this time an item is still present in the buffer, it is perfectly retrieved. If an item is not present in the buffer, a search of the long-term store is made. This search is imperfect and the greater the number of items in the long-term store, the smaller the probability that any particular one will be retrieved. The model is applied to a set of experiments on paired-associate memory with good success. Author

N67-34749*# Stanford Univ., Calif. Inst. for Mathematical Studies in the Social Sciences.
THE EFFECTS OF REINFORCEMENT INTERVAL ON THE ACQUISITION OF PAIRED-ASSOCIATE RESPONSES
L. Keller, W. J. Thomson, J. R. Tweedy, and R. C. Atkinson 10 Dec. 1965 34 p refs
(Grant NGR-05-020-036)
(NASA-CR-87473; TR-88) CFSTI: HC $3.00/MF $0.65 CSCL 05J

The length of the reinforcement interval (RI) in paired-associate learning was studied using a within-subjects design to eliminate confounding of presentation rate with the time between successive presentations of items. Forty Ss were run for fifteen trials on a 24-item list with RI's of 1/2, 1, 2, and 4 sec. Results indicated: (a) mean errors were a decreasing function of RI; (b) mean errors for items meeting a criterion were not related to RI, but the proportion of items meeting criterion was an increasing function of RI; (c) precriterion mean latencies increased slightly for both correct and incorrect responses, whereas postcriterion latencies decreased; (d) the proportion of correct responses decreased as the number of intervening items increased, but the latency measure showed no effect. Several alternative models dealing with RI effects are proposed and evaluated against these data. None of the models prove entirely satisfactory. Author

N67-34812*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
A RESEARCH STUDY TO DEFINITIZE A BIO-ISOLATOR SUIT SYSTEM (BISS) Final Report
25 Aug. 1967 573 p
(Contract NAS1-6537)
(NASA-CR-66441; Doc.-67SD888) CFSTI: HC $3.00/MF $0.65 CSCL 06Q

A program was conducted to develop the functional requirements for a Bio-Isolator Suit System (BISS) by investigating and defining system criteria, concepts, and materials along with an integrated test plan and a mockup test program. The objectives, accomplishments, and conclusions in each of these areas are described together with recommendations for further study to advance the developmental status of the BISS system. Specifications augmented by technical discussions are appended. R.N.A.

N67-34826# Joint Publications Research Service, Washington, D. C.
A DEVICE FOR CONTROLLED FLOW CULTIVATION OF ALGAE WITH AUTOMATIC MEASUREMENT, RECORDING, AND REGULATION OF SUSPENSION DENSITY
L. N. Tsoglin, V. Ye. Semenenko, F. M. Bochcher, and Yu. N. Filippovskiy *In its* Controlled Biosynthesis 24 May 1967 p 32–39 refs (See N67-34821 20-04)

The controlled flow cultivation of micro-algae is briefly reviewed in the light of current literature. The present need for instruments capable of operating in a wide range of suspension densities up to several billion cells per cubic centimeter is cited. The controlled flow cultivation of algae with cybernetic equipment was undertaken and proved to be satisfactory. R.U.

N67-34938# Naval School of Aviation Medicine, Pensacola, Fla.
EVALUATION OF SEVERAL EXPERIMENTAL AVIATION SELECTION TESTS
James R. Berkshire Mar. 1967 23 p refs
(NAMI-1003; AD-653441) CFSTI: HC $3.00/MF $0.65

The report describes the development and experimental evaluation of several measures intended to augment the present naval aviation selection test battery. These include the Altitude Judgment test, the Maneuvers test, a short-form Instrument Comprehension test, a socioeconomic scale, and ratings of the prestige and security of the aviators job. Author (TAB)

N67-35000# Royal Aircraft Establishment, Farnborough (England).
IMPROVEMENTS TO FLIGHT INSTRUMENTS TO ENABLE THE PILOT TO CONTROL THE AIRCRAFT RIGHT TO TOUCH-DOWN [AMELIORATION DES INSTRUMENTS DE BORD PERMETTANT LE CONTROLE DE L'AVION JUSQU'AU SOL]
R. Lami Jan. 1967 20 p Transl. into ENGLISH from Tech. Sci. Aeronaut. Spatiales (Paris), v. 1, 1965 p 7–12
(RAE-LIB-TRANS-1214) CFSTI: HC $3.00/MF $0.65

The requirements for the pilot to allow an aircraft to land in bad or zero visibility were reviewed and related to the shortcomings of present instruments. Use of the pilot himself rather than a completely automatic system was advocated. Current developments in flight path monitoring and presentation were examined within this context. Author

N67-35100# California Univ., Los Angeles. Dept. of Engineer-
BIOTECHNOLOGY LABORATORY Progress Report
John Lyman 15 Apr. 1967 29 p refs
(Rept.-67-22)

Research work efforts in upper extremity prosthetics are reported. Experiments with a pneumatic arm; studies of a northwestern attitudinally controlled elbow; and studies of an electric hand, are reviewed. Short summaries of work concerning the exploration of minor surgical methods for developing new body control sites; new harnessing techniques for transducers; and the development and testing of control for a practical arm prototype, are presented. Research activities on the performance of human operators of tracking systems; on sensory motor control; and on criteria and measures of value in engineering design, are summarized. Other work project efforts are also discussed. L.S.

N67-35130*# Oak Ridge Associated Universities, Tenn.
A SOURCE ARRANGEMENT FOR A LOW-EXPOSURE-RATE TOTAL-BODY IRRADIATION FACILITY FOR MAN
Patricia Dalton and Roger Cloutier May 1967 211 p refs Sponsored by NASA
(Contract AT(40-1)-GEN-33)
(NASA-CR-87798; ORINS-52) CFSTI: HC $3.00/MF $0.65 CSCL 06B

A facility for therapeutic, total-body irradiation of patients at exposure rates of 0.5, 1, and 5 R/hr is under construction. Preliminary to architectural and engineering designs, a study was made of possible arrangements of sources to provide the facility's radiation field. This field must be large and uniform enough to permit patients to move about during treatment periods of up to two weeks. The treatment room required is at least 8 ft high and 14 ft square with a variation in the exposure rate of 10% or less. Exposure rates and isodose lines have been calculated for 15 configurations of 1, 2, 4, 6, 8, and 10 sources assuming that the exposure rate at a point is proportional to the inverse square of the distance to the source. Computer data describing the radiation fields from these source arrangements are included. The facility consists of a treatment room 8 ft high and 16×16 ft in area centered inside a building 18×30×30 ft. Author (NSA)

N67-35195 Royal Aircraft Establishment, Farnborough (England).
AN ASSESSMENT OF THE R.A.E. TYPE 'B' FULL PRESSURE SUIT AS A PARACHUTING GARMENT
G. F. Turnbull and C. B. Bolton Oct. 1966 29 p refs
(RAE-TR-66330)

Doubts having been expressed about the downward view and safety of the wearer of a full pressure suit with a folding helmet during an emergency parachute descent, falls and simulated drops were performed at a parachute training school, followed by three live parachute descents. These tests indicate that this garment is not markedly worse for parachuting than other assemblies provided one valve is moved. Author

N67-35228# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Speech Communication.
SPEECH TRANSMISSION LABORATORY Quarterly Progress and Status Report
15 Apr. 1967 52 p refs
(STL-QPSR-1/1967)

CONTENTS:

1. PERTURBATION FUNCTIONS FOR THE DETERMINATION OF VOCAL-TRACT AREA FUNCTIONS FROM VOCAL-TRACT EIGENVALUES J. M. Heinz p 1–14 refs (See N67-35229 20-05)
2. STUDIES OF ARTICULATORY COORDINATION S. Oehman p 15–20 refs (See N67-35230 20-05)
3. ESTIMATING SHORT-TERM CONTEXT-DEPENDENCE OF FORMANT PATTERN PERCEPTION II: RESULTS B. Lindblom and M. Studdert-Kennedy p 21–24 refs
4. THE SOURCE SPECTRUM OF DOUBLE REED WOOD-WIND INSTRUMENTS F. Fransson p 25–27 refs

N67-35229# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Speech Communication.
PERTURBATION FUNCTIONS FOR THE DETERMINATION OF VOCAL-TRACT AREA FUNCTIONS FROM VOCAL-TRACE EIGENVALUES
J. M. Heinz *In its* Speech Transmission Lab.: Quart. Prog. and Status Rept. 15 Apr. 1967 p 1–14 refs (See N67-35228 20-05)

Basic perturbation formulas are derived in order to include boundary perturbation terms and to provide formulas in terms of the change in logarithm of the area function for the case of an arbitrary area function. It is shown that, even for rather general boundary conditions, the changes in the eigenvalues due to small changes in both the area function and the boundary conditions can be determined entirely in terms of the unperturbed eigenfunctions. Emphasis is focused on the generalization of results for first-order perturbations about a uniform area function to the case of first-order perturbations about an arbitrary area function. An infinite glottal impedance is assumed. The results show that it is possible to determine a set of perturbation functions for an arbitrary given area function so that, if the change of the logarithm of the area function is expanded in these functions, each function to first order affects the shift of only one eigenvalue corresponding to an admittance pole (formant frequency) or admittance zero. M.G.J.

N67-35230# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Speech Communication.
STUDIES OF ARTICULATORY COORDINATION
S. Oehman *In its* Speech Transmission Lab.: Quart. Prog. and Status Rept. 15 Apr. 1967 p 15–20 refs Presented at the 73d Meeting of the Acoust. Soc. of Am., New York, 19–22 Apr. 1967 (See N67-35228 20-05)

Examples of phonetic variability of phoneme production are described and depicted. These include schematized sound spectrograms of vowel–consonant–vowel utterances; X-ray tracings of u, i, and a, and numerical representation of vocal tract shapes; a scheme for generating time-varying vocal tract shapes exhibiting coarticulation; control parameters of a coarticulation model for vowels and consonants; and prediction of vowel reduction. The possibility is demonstrated of devising relatively simple articulatory models that are compatible both with observed acoustic variability and with a hypothesis about invariant phoneme commands. The model is also discussed in relation to electromyographic data on speech production. M.G.J.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N67-34015 Centre d'Etude de l'Energie Nucléaire, Mol (Belgium).
PREPARATION OF LABELLED MOLECULES BY GAMMA IRRADIATION [PREPARATION DE MOLECULES MARQUEES PAR IRRADIATION GAMMA] Final Report
R. Constant, R. Lecocq, F. Provoost, and P. Vasilescu Brussels, EURATOM, Jul. 1967 77 p refs In FRENCH; ENGLISH summary (Contract EURATOM-065-6411 RISB) (EUR-3496-f)

Under the influence of gamma irradiation of the CO_2–CH_4 mixture, various substances are seen to form which can be divided into three phases: the condensable phase at −78°C, containing some twenty substances with different organic functions; the non-condensable phase at −78°C, in which the main substances formed are ethane and carbon monoxide; and the polymer phase of the ⟨⟨polyketene⟩⟩ type. We used gas-phase chromatography for identifying and analyzing the substances formed which are condensable and non-condensable at −78°C. Infra-red spectroscopy was employed for analyzing the polymer fracture. Two of the substances formed during radiolysis of the CO_2–CH_4 system are of particular interest, i.e., acetone and methyl-ethyl-ketone, which two substances alone represent about 75% of the phase condensable at −78°C. We studied the influence of certain parameters (molar ratio, pressure, total dose absorbed, temperature, presence of solid or gaseous additives) on the radiolysis of the $CO_2 + CH_4$ mixture, in autoclaves or quartz ampoules. The ketone-formation yields were improved. Author

N67-34027# National Bureau of Standards, Washington, D. C.
HIGH TEMPERATURE PROPERTIES AND DECOMPOSITION OF INORGANIC SALTS. PART 1: SULFATES
K. H. Stern and E. L. Weise 1 Oct. 1966 48 p refs (NSRDS-NBS-7) GPO: $0.35

The literature dealing with the high-temperature behavior of inorganic sulfates has been critically reviewed. Free energy functions of reactants and products of the decomposition reactions were calculated and have been tabulated from 298°K up to as high a temperature as possible. Free energy functions, equilibrium constants of reactions, and partial pressures of gaseous components were tabulated. Auxiliary data on phase transitions, densities, and kinetics of chemical decomposition have also been included. Author

N67-34043 United Kingdom Atomic Energy Authority, Wantage (England). Isotope Research Div.
THE PRODUCTS OF THE RADIATION INITIATED SULPHOXIDATION OF DODECANE
P. R. Hills and M. W. Spindler Mar. 1967 24 p refs (AERE-R-5434) CFSTI: HC $3.00/MF $0.65

The irradiation of dodecane in the presence of sulphur dioxide and oxygen results in the formation of dodecane persulphonic acid by a chain process. This material is unstable and undergoes further reaction to form a sulphoxidation oil of complex composition. The properties of the oil which are relevant to its potential use as an intermediate for the preparation of a biodegradable detergent have been established. The main components of the oil have been separated and identified. Dodecane mono- and di-sulphonic acids together with sulphuric acid comprise over 90% of the crude product and evidence has been obtained for other minor components which arise during irradiation or subsequent processing. Author

N67-34060# Arizona State Univ., Tempe. Dept. of Chemistry.
THE SOLID STATE CHEMISTRY OF HYDROGEN COMPOUNDS Final Technical Progress Report
M. O'Keeffe, Y. Ebisuzaki and W. J. Kass Jun. 1967 48 p refs (Contract Nonr-2794(04)) (Rept.-6; AD-653891) CFSTI: HC $3.00/MF $0.65

Research on the interactions of hydrogen in solids is summarized and a bibliography of publications is given. New results are given for the permeation of hydrogen in platinum. An extensive account of the solubility of hydrogen in transition metals and alloys is presented. It is concluded that the screened-proton model gives the best account of hydrogen in these systems. Author (TAB)

N67-34056# Pennsylvania State Univ., University Park. Materials Research Lab.
CRYSTAL CHEMISTRY AT ELEVATED PRESSURE AND MODERATE TEMPERATURES. Final Report
Rustum Roy and Frank Dachille 31 May 1967 23 p refs (Contract Nonr-656(20)) (AD-653887) CFSTI: HC $3.00/MF $0.65

The guidelines and major emphases of the research conducted during the nearly nine year period of support by the Office of Naval Research are summarized. The substantive results were presented at intervals as 22 Technical Reports and 25 publications, plus 4 publications from closely related work branching from this project. A bibliography is included. Author (TAB)

N67-34062# General Electric Co., Schenectady, N. Y. Research and Development Center.
CARBON DIOXIDE DETERMINATION DURING THE GALVANOSTATIC OXIDATION OF ADSORBED PROPANE INTERMEDIATES
W. T. Grubb and M. E. Lazarus Dec. 1966 3 p refs (Contracts DA-44-009-AMC-479(T); DA-44-009-ENG-4909; ARPA Order 247) (Rept.-66-C-485) CFSTI: HC $3.00/MF $0.65

Propane adsorbed at 0.2 volt on a Teflon bonded platinum black fuel cell electrode formed a residue which was not removed by exhaustive cathodic hydrogenation. This residue was oxidized at constant current with measurement of the rate of production of carbon dioxide using gas chromatography. The results show that the nonhydrogenatable residue contains partially oxidized carbon and probably has the empirical formula $C_xH_yO_z$. Author

N67-34079# Argonne National Lab., Ill.
CHEMICAL ENGINEERING DIVISION Semiannual Report, Jan.–Jun. 1966
R. C. Vogel, Milton Levenson, J. H. Schraidt, and J. Royal Nov. 1966 235 p refs (Contract W-31-109-ENG-38) (ANL-7225) CFSTI: HC $3.00/MF $0.65

Research progress is reported under the following headings: compact pyrochemical processes, fluidization and volatility processes, materials chemistry and thermodynamics, chemical and energy transfer problems in reactor safety, energy conversion, nuclear constants, and analytical and development. NSA

N67-34081# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
THE DETERMINATION OF STRONTIUM 90 IN ENVIRONMENT MATERIALS
P. S. Davis and N. R. Piper Feb. 1967 17 p refs (AAEC/TM377) CFSTI: HC $3.00/MF $0.65

A method for determining strontium 90 in environmental materials is described. It consists of the ion exchange separation

of strontium from calcium at an elevated temperature by careful control of pH and the molar ratio of Ca:EDTA, followed by scavenging. Activity of the Sr-90 is determined by counting the yttrium 90 daughter. Recovery of strontium is determined with Sr-85 tracer. Typical recovery of strontium is 70–90 per cent. Procedures are given for analysis of milk, vegetation, meat and fish, rainwater, and oyster shell and reference is made to analysis of oyster flesh, soil and effluent. Author

N67-34088# United Kingdom Atomic Energy Authority, Harwell (England). Analytical Sciences Div.
ANALYTICAL METHOD—THE DETERMINATION OF YTTRIUM IN ALLOY STEELS
G. S. Spicer Jun. 1957 8 p
(AERE-AM-104) CFSTI: HC $3.00/MF $0.65

The procedure described uses an isotope dilution technique to determine yttrium in steels which may also contain aluminium. The yttrium is separated as the fluoride and a source in suitable form prepared and counted. The specific activity of this source is compared with standards prepared from a known amount of yttrium. The method has been applied to 15/4/1 chromium–aluminium–yttrium steels and 20/25/1 stainless steels containing up to 1% of yttrium. The accuracy and precision have been determined at the 0.1 and 1% levels. A coefficient of variation of about 3% was obtained at both levels. The method was found to have a positive bias of 1% at the 1% yttrium level and 2% at the 0.1% yttrium level. Author

N67-34118# Technische Hochschule München (West Germany).
FORMATION AND STRUCTURE OF IONOGENIC AND NON-IONOGENIC CARBON MONOXIDE COMPLEXES OF PLATINUM METALS [BILDUNG UND STRUKTUR IONOGENER UND NICHTIONOGENER KOHLENOXIDKOMPLEXE VON PLATINMETALLEN]
Volker Frey (Ph.D. Thesis) [1966] 65 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

A new reaction principle was applied to prepare a number of heterogeneous cationic carbon oxide complexes from carbonyl halogenides of iron, ruthenium, and osmium with halogen acceptors such as $AlCl_3$, $AlBr_3$, and $FeCl_3$ using benzol suspensions under CO standard pressure. In addition to the bis-phosphine substituted carbonyl cations of iron, ruthenium, and osmium, the tris-stibic substituted cationic carbon oxide complexes of rhodium and iridium were investigated. Described are also several iridium carbonyl halogenides with N-bases and compounds of the tri-valent phosphorus and its homologs as ligands. The structures are discussed in detail based on IR spectra and dipole measurements. Transl. by K.W.

N67-34120# Metaalinstituut TNO, Delft (Netherlands).
INVESTIGATION OF HOT PHOSPHATES [SPEURWERK WARM FOSFATEREN]
M. J. Reidt 31 May 1967 15 p In DUTCH
(M-67-363; TDCK-46184C) CFSTI: HC $3.00/MF $0.65

Tests were conducted to evaluate several methods of treating relatively small steel parts with phosphate agents prior to painting. The phosphate and paint systems were applied to sample plates and evaluated for mechanical properties, corrosion inhibition, and compatibility. Detailed results of the tests are presented in tables, and the various systems are ranked in order of effectiveness. Transl. by K.W.

N67-34123 Atomic Energy Establishment, Trombay (India).
STUDIES ON THERMAL ANNEALIEG OF NEUTRON-IRRADIATED TRIS-DIPYRIDYL COBALT (III) PERCHLORATE—REDISTRIBUTION OF ELECTRONS AMONG THE DONORS
Amar Nath and S. P. Vaish 1966 20 p refs
(AEET-271)

Thermally treated and untreated anhydrous samples of tris-dipyridyl Co(III) perchlorate were hydrated at 30° in air at a relative humidity of 93%. Some of them were chilled at −78° while others were kept at 30° for prolonged periods before chilling at −78°. The chilled samples were neutron irradiated at −78°. Thermally treated samples chilled immediately after hydration exhibit a much faster rate of thermal annealing as compared to the latter and to the trihydrate. These observations have been interpreted on the basis of the variable depth electron donors–isotopic exchange model which postulates an annealing rate proportional to the free electron density. Evidence is presented for the creation of electron traps and electron-hole recombination centers during thermal treatment of the anhydrous form and for populating of the electron traps with electrons to form shallow donors during hydration through exo-electron emission. Hence, in the freshly hydrated samples kept at 30° for prolonged periods before chilling and irradiation, a considerable amount of depopulation of the shallow donors takes place resulting in a slower rate of post-recoil thermal annealing. Author

N67-34126# Battelle Inst., Frankfurt am Main (West Germany).
EXPERIMENTAL INVESTIGATION OF CHEMICAL REACTIONS OF URANIUM, URANIUM DIOXIDE, AND URANIUM CARBIDE WITH AIR AND WATER VAPOR IN THE TEMPERATURE RANGE FROM 600 TO 1300°C [EXPERIMENTELLE UNTERSUCHUNG CHEMISCHER REAKTIONEN VON URAN, URANDIOXID UND URANCARBID MIT LUFT UND WASSERDAMPF IM TEMPERATURBEREICH VON 600 BIS 1300°C]
Eva Poeschel and R. Skoutajan Bad Godesberg, W. Germany, Bundesmin. fuer Wiss. Forschung, Feb. 1967 112 p refs In GERMAN; ENGLISH summary
(BMWF-FBK-67-13)

The reactions were studied thermogravimetrically at O_2 or H_2O partial pressures of 0.1 to atm, respectively, and a total pressure of 1 atm. For U/air and UC/air, a linear time law was found, for $U/H_2O(g)$ a parabolic law, and for $UO_2/H_2O(g)$ a parabolic or a linear law, depending on the temperature. No reaction was observed for $UO_2/H_2O(g)$ during brief periods; that of $UC/H_2O(g)$ depended on the storage time. The activation energy for U/air amounts to 6.4 kcal/gram-atom, that of UO_2/air to 7.0 and 23.6 kca/mole in the validity range of the linear and the parabolic time law, respectively, and to 15.6 to 18.9 kcal/gram-atom for $U/H_2O(g)$. The reaction rates for U/air and UC/air are proportional to the pressure; for $U/H_2O(g)$ the effect of pressure was ill-defined. In the validity range of the linear time law for UO_2/air, the reaction rate RG = const. $xp^{0.8}$; in the range of the parabolic time law the reaction rate is pressure-independent. The conversions U/air (incomplete oxidation) and $U/H_2O(g)$ yield UO_2; UO_2/air and UC/air give U_3O_8. The heat fluxes calculated from the conversions range from 10 to 370 cal/cm^2 min. Author (NSA)

N67-34130# Bureau of Mines, Rolla, Mo. Metallurgy Research Center.
REACTION OF TUNGSTEN–COBALT ALLOYS WITH OXYGEN AT 1,000° AND 1,100°K
Robert M. Doerr, L. A. Neumeier, and J. W. Jensen Aug. 1967 27 p refs
(BM-RI-6998)

The oxidation behavior of selected tungsten–cobalt alloys was determined. Specimens of W and W–Co containing 0.7, 1.7, 3.4, and 9.7 weight-percent Co were subjected to pure O_2 at 1,000° and 1,100°K, and specimens of W–Co containing 29.8 weight-percent Co, at 1,100°K. Reactions kinetics were determined volumetrically. For specimens other than those containing 29.8 percent Co, the reactions proceeded at about a constant rate at

either temperature, indicating the formation of a scale of constant protectivity; the reaction rates were essentially independent of the Co concentration. The scales on these alloy specimens consisted principally of WO_3 and $CoWO_4$. Specimens of a 29.8 weight-percent Co alloy, consisting primarily of the W_6CO_7 phase, oxidized with only slight deviations from the parabolic rate law at 1,100°K. The protective scale on these specimens consisted chiefly of Co_3O_4, $CoWO_4$, and $W_{18}O_{49}$; Co_3O_4 was outermost, and the $W_{18}O_{49}$ was adjacent to the alloy. The results suggest that the Co-rich outer scale inhibited the inward transport of O to an extent sufficient to greatly limit the amount of the nonprotective WO_3 formed, so that protective $W_{18}O_{49}$ formed instead. Author

N67-34132 Cekmece Nuclear Research Center, Istanbul (Turkey).
SYNTHESES BASED ON CHOLANIC ACID, Δ^{23}-CHOLENE AND 23-AMINO NORCHOLANE
Envare Unseren 9 Apr. 1967 13 p refs
(CNAEM-45) CFSTI: HC $3.00/MF $0.65

Reduction of cholanic acid (III) with lithium aluminum hydride gave cholanyl alcohol (IV). Benzoate, chloride, pyridinium chloride hydrate, ethyl carbonate, S-methyl xanthate derivatives of cholanyl alcohol have been prepared. Δ^{23}-cholene has been obtained by the pyrolysis of the last two products. Osmium tetroxide hydroxylation of Δ^{23}-cholene afforded 23,24-dioxy cholane (VIII). Schmidt reaction on cholanic acid gave 23-amino norcholane (IX). Acetyl, benzoyl, and tosyl derivatives of the amine have been prepared. Reaction with potassium isocyanate gave norcholanyl urea (IX a). Norcholanic acid (X) has been obtained by the alcaline permanganate oxidation of 23-amino norcholane. Lithium aluminum hydride reduction of norcholanic acid gave norcholanyl alcohol (XI). Author

N67-34159# European Atomic Energy Community, Geel (Belgium). Joint Nuclear Research Center.
THE DETERMINATION OF CADMIUM IN CADMIUM–TIN ALLOYS—AN OSCILLO-POLAROGRAPHIC METHOD
V. Verdingh and H. Cuyvers Jul. 1967 17 p refs
(EUR-3494.e) CFSTI: HC $3.00/MF $0.65

A simple polarographic method that allows the determination of Cd in Cd–Sn alloys is described. Sn is removed by treatment of the Cd–Sn solution with a mixture of HBr–Br_2. Small amounts of Sn reduce the height of the Cd peak. Knowing the Sn peak height a correction can be applied. 1N HCl was chosen as an indifferent electrolyte. The coefficient of variation of the method is less than 1%. Author

N67-34160# Battelle Inst., Frankfurt am Main (West Germany).
EXPERIMENTAL INVESTIGATION OF CHEMICAL REACTIONS OF URANIUM, URANIUM DIOXIDE, AND URANIUM CARBIDE WITH AIR AND WATER VAPOR IN THE TEMPERATURE RANGE BETWEEN 1000 AND 2200°C [EXPERIMENTELLE UNTERSUCHUNG CHEMISCHER REAKTIONEN VON URAN, URANDIOXID UND URANCARBID MIT LUFT UND WASSERDAMPF IM TEMPERATURBEREICH VON 1000 BIS 2200°C]
N. Henzel and A. Kleine-Tebbe Bad Godesberg, W. Germany, Bundesmin. fuer Wiss. Forschung, Feb. 1967 121 p refs In GERMAN; ENGLISH summary
(BMWF-FBK-67-12)

The initial phase of the reactions, isothermally investigated to 2200°C in the framework of a reactor safety program, yields UO_2, UO_{2+y} or U_3O_8 respectively. The reaction rate is proportional to the partial pressure of the gas, but hardly affected by the absolute pressure. At standard pressure it is a linear function of time for the system U/air, for others a higher (maximum third power) function. At 0.1 atm partial pressure in argon, linear time functions are found, except for UC/H_2O(g) (higher order) and U/H_2O(g) (erratic). Arrhenius plots show activation energies around 10 kcal/U for U/air, U/H_2O(g), and UC/air, in contrast to 50 kcal/mole for UO_2/H_2O(g). No definite value was found for UC/H_2O(g). The UO_2/air curve has a maximum at 1500°C. According to a pessimistic energy balance, based on the reaction enthalpies and simplified estimates of the heat losses, selfsustaining reactions are quite possible for U and UC, not for UO_2, systems, although their probability decreases with increasing temperatures. Author (NSA)

N67-34164# Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe.
RESEARCH IN URANIUM NITRIDES AND CARBONITRIDES [UNTERSUCHUNGEN AN URANNITRIDEN UND CARBONITRIDEN]
A. Naoumidis Mar. 1967 118 p refs In GERMAN
(JUL-472-RW)

The following systems were studied: (1) the single phase of U_2N_3–UN_2; (2) the formation of the beta phase of U_2N_3; and (3) the system UN–UC–UO. Preparation of the various phases was followed by roentgenographic and metallographic examinations. The nitrogen balance pressures of the phases were measured as a function of temperature and composition; from these measurements were calculated the thermodynamic values ΔG, ΔH, and ΔS of the formation of the various phases. The composition of the compounds that were obtained was determined by means of an N_2 analysis which was modified during the course of this study. Transl. by K.W.

N67-34165# Kernforschungsanlage, Juelich (West Germany). Institut fuer Radiochemie.
ON COMPLEX CHEMISTRY AND POLAROGRAPHY OF "TECHNETIUM" [ZUR KOMPLEXCHEMIE UND POLAROGRAPHIE DES TECHNETIUMS]
K. Schwochau Apr. 1967 88 p refs In GERMAN
(JUL-465-RC) CFSTI: HC $3.00/MF $0.65

In order to characterize the complex-chemical and polarographic behavior of the radio element technetium, the crystal structures, absorption spectra, magnetic moments, electron spin resonance spectra, velocities of ligand exchange, and complex formation constants of the hexahalogen technetates (IV) were measured. These properties were compared with those of analog compounds of the homolog element rhenium. Furthermore, the polarographic reduction of pertechnetate ions was examined by means of ac and dc polarography to determine conductometrically and radiometrically the diffusion coefficient of the TcO_4. The application of polarography in the characterization of technetium was evaluated. Transl. by K.W.

N67-34169# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
NICKEL PLATING URANIUM: REVIEW OF LABORATORY STUDIES
J. R. Lundquist, R. L. Braun (Calif. Univ., Livermore), and R. W. Stromatt 16 Jan. 1967 34 p refs Presented at the Am. Electroplaters Soc. Natl. Conv., Dallas, 19–22 Jun. 1967 Submitted for publication
(Contract AT(45-1)-1830)
(BNWL-SA-1030; CONF-670606-2) CFSTI: HC $3.00/MF $0.65

Electroplating nickel onto uranium is discussed with respect to development of an improved anodic etch for the uranium, a method for determining optimum pickling conditions and the classification of anodic etches, and the evaluation of the nickel plating solution. Anodization of uranium in H_2SO_4–HCl was found to produce a surface on which a nickel coat with good adherence and low pore density can be plated. Several etching techniques are classified by the electrode potential assumed by uranium when immersed in a $NaClO_4$ solution. The uranium potentials are also used to determine optimum pickling conditions for the uranium after the anodic etch. Several plating solutions are evaluated on the basis of their reactivity toward uranium and the adherence and porosity of the plates. Author (NSA)

N67-34196# General Electric Co., Schenectady, N. Y. Research and Development Center.
A STUDY OF INTERMEDIATES ADSORBED ON PLATINIZED PLATINUM DURING THE STEADY-STATE OXIDATION OF METHANOL, FORMIC ACID, AND FORMALDEHYDE
M. W. Breiter Nov. 1966 10 p refs
(Rept.-66-C-427)

A combination of charging curves and gas chromatography was used in conjunction with platinized platinum electrodes of large real surface to study the intermediates that are formed under steady-state conditions during the anodic oxidation of methanol, formic acid, and formaldehyde in sulfuric acid solutions. It appears that the composition of the adsorbed intermediates is very similar in the three cases. On the average, the oxidation of one intermediate requires two electrons. The behavior of adsorbed CO is slightly different from that of the intermediates. Author

N67-34211# Pennsylvania Univ., Philadelphia. John Harrison Lab. of Chemistry.
THE ELECTROMAGNETIC ACTIVITY OF PORPHIN DERIVATIVES Final Report, 1 Jun. 1963–30 Jun. 1967
30 Jun. 1967 8 p refs
(Contract DA-31-124-ARO(D)-101)
(AD-653842) CFSTI: HC $3.00/MF $0.65

The basic objective of the research was to explore the possibilities of using porphin derivatives as model compounds in a study of structure–property and structure–reactivity relationships. The large number of porphyrin structures available, their wide range of chemical reactivity, their correspondingly wide range of interesting physical properties, and their fundamental biological importance recommended porphyrins as suitable materials for such a research program. Of particular interest were the electromagnetic properties of oriented films and crystals of these materials and their relationships to corresponding electrochemical parameters in solutions of these materials that are of biological interest. Author (TAB)

N67-34259# Bureau of Mines, Reno, Nev.
REACTION RATE OF SOLID YTTRIUM METAL WITH MOLTEN LITHIUM FLUORIDE
Bernard Porter, R. E. Meaker, and T. A. Henrie Aug. 1967 19 p refs
(BM-RI-7008)

The rate of the heterogeneous reaction between reactor-grade yttrium and lithium fluoride in lithium fluoride–yttrium fluoride mixtures was measured using a quartz spring balance. At 950°C the magnitude of the rate of reaction is 10^{-5} grams of yttrium/cm^2-sec. The heat of activation for the reaction is 38.3 kilocalories per mole of LiF. A surface-controlled mechanism is proposed in which LiF is adsorbed on the yttrium metal surface. An activated complex is formed when additional LiF reacts with the adsorbed LiF-metal site. The activated complex then decomposes to the products, which are lithium metal and YF_3. The importance of the reaction in the electrowinning of yttrium metal from fluoride electrolytes is discussed. Author

N67-34289# Farbenfabriken Bayer, A. G., Leverkusen (West Germany). Organisch Analytisches Laboratorium.
DEVISING, REVISING AND STANDARDIZING ANALYTICAL PROCESSES FOR DETERMINING POLYPHENYLS AND SOME OF THEIR ORGANIC OR INORGANIC IMPURITIES [AUSARBEITUNG UND NACHARBEITUNG SOWIE STANDARDISIERUNG VON ANALYTISCHEN VERFAHREN ZUR BESTIMMUNG DER POLYPHENYLE UND EINIGE IHRER ORGANISCHEN BZW ANORGANISCHEN VERUNREINIGUNGEN] Annual Report, 15 Feb. 1965–15 Feb. 1966
Brussels, EURATOM, Jun. 1967 25 p In GERMAN; ENGLISH summary
(Contract EURATOM-203-65-3 ORGC)
(EUR-3466.d) CFSTI: HC $3.00/MF $0.65

The aims of the contract were to revise, standardize and possibly improve analytical procedures for determining polyphenyls and their organic or inorganic impurities. Procedures for analyzing the following components were studied: ash, iron, sulphur, chlorine, oxygen, boron and high-boilers. Special mention should be made of tracer acid determination by Unterzaucher's method. This is based on techniques which have been used partly in American nuclear research centers and Euratom and partly by the contractors. Critical comparison of the various methods enabled the following points to be determined: the advantages and disadvantages of a given method; what improvements must be effected in order to obtain the optimum analytical estimate of the substances to be tested; the sensitivities, determination limits and standard deviations of the various methods. As a result, clear instructions have been drawn up which can be applied even by laboratories which do not specialize in the analysis of polyphenyls. In conclusion, there is a ring-analysis series with six different laboratories. Author

N67-34291# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
A FIVE YEAR PROGRAMME FOR RADIOISOTOPE PRODUCTION AT THE RESEARCH ESTABLISHMENT
R. E. Boyd, U. Engelbert, J. N. Gregory, and G. L. Miles Nov. 1966 20 p
(AAEC/TM360) CFSTI: HC $3.00/MF $0.65

Plans for radioisotope production over the period 1966–71 are summarized, and it is indicated how these are based on present trends of demand for radioisotopes. The program is discussed in terms of available staff and facilities; while some small staff increases will be required, the facilities presently being commissioned should be adequate over this period. Author

N67-34309# Bureau of Mines, Boulder City, Nev.
ELECTROREFINING YTTRIUM
C. C. Merrill and M. M. Wong Sep. 1967 15 p refs
(BM-RI-7018)

Studies were made to determine the amenability of yttrium to fused-salt electrorefining in a controlled atmosphere. Tests were conducted in a LiCl–YCl_3 electrolyte system at 710°C. The major variables studied were the YCl_3 content of the electrolyte, from 1.7 to 13.4 mol percent, and the initial cathode current density, from 410 to 1,630 amperes per square foot. Vacuum distillation was employed to remove salt from the deposited metal. Metallic impurities, except for lithium, could be reduced to near or below their lower analytical limits, ranging from 10 ppm for Cu to 300 ppm for Ta; reduction of oxygen content, however, was accomplished only in metal produced from electrolytes with 5.4 mol percent YCl_3 or less. Initial cathode current density had little effect on the purity of the product. Author

N67-34310# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
SPECTROPHOTOMETRIC ANALYSIS OF THIN ANTIMONY/ARSENIC ALLOY FILMS
L. Tomlinson May 1967 9 p refs
(AERE-M-1886) CFSTI: HC $3.00/MF $0.65

A spectrophotometric method is described for determining antimony and arsenic (without separation) in thin antimony/arsenic alloy films containing 0 to 50 μg of each element. Author

N67-34313# California Univ., Davis. Dept. of Chemistry.
STUDIES ON ELECTRICALLY EXPLODED WIRES Final Report

Charles P. Nash May 1967 7 p refs Prepared for Lawrence Radiation Lab.
(Contract W-7405-ENG-48)
(UCRL-13296) CFSTI: HC $3.00/MF $0.65

Developments in spectroscopic studies on exploding wires and infrared spectra of adsorbed species are reported. Spectra of the exploding wires were obtained with both space and time resolution. Space resolution was achieved, using the stigmatic character of the spectrograph, by turning the wire so that its axis is at right angles to the spectrograph slit. The method for obtaining the infrared spectra of unsaturated hydrocarbons adsorbed on metal spheres, which are the recondensation products of a wire exploded at 1 atm ambient pressure of argon, is described. NSA

N67-34326# Oak Ridge National Lab., Tenn.
ELECTROCHEMICAL MEASUREMENTS ON CRYSTAL-BAR ZIRCONIUM IN OXYGENATED 0.05 M K_2SO_4 SOLUTIONS, BETWEEN 200° AND 240°C
H. S. Gadiyar [1967] 42 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1834) CFSTI: HC $3.00/MF $0.65

Electrochemical measurements on crystal-bar Zr in oxygenated 0.05M K_2SO_4 solution were made between 200 and 240°C, to measure the rates of corrosion and film growth at different temperatures. The rate–time plots obtained were analyzed for kinetics of film growth. Author (NSA)

N67-34327# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
THE EMISSION SPECTROCHEMICAL ANALYSIS OF IMPURITIES IN PLUTONIUM DIOXIDE
L. S. Dale and H. J. Hurst Feb. 1967 18 p refs
(AAEC/TM376) CFSTI: HC $3.00/MF $0.65

A description is given of a method used at the A.A.E.C. Research Establishment for the analysis of impurities in plutonium dioxide. Plutonium is separated from its impurities by adsorption on to anion exchange resin. The effluent containing the impurities is spectrographically analyzed using a graphite spark technique. Pyrolytic graphite electrodes which are nonporous do not require sealing are used in preference to the normal greased electrodes which are unsuitable for the analysis of acidic solutions. The plutonium is analyzed for Fe, Al, Mg, Mn, Ni, Cr, Pb, Cd, Co, Ca, Sn, Mo, and Zn using vanadium as internal standard. The overall precision of the method is estimated to be ± 20 percent. Author

N67-34329# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering and Process Technology Div.
PROCESSING IN LIMITED GEOMETRY, PART 15—A DEMONSTRATION OF PHYSICAL MIXING FOR OXIDE FUELS
K. R. Poole and G. P. Wall Apr. 1967 14 p refs
(AERE-M-1884) CFSTI: HC $3.00/MF $0.65

A small model powder mixer of the Lödige-type is used to blend UO_2/ThO_2 and UO_2/PuO_2. The homogeneity obtained in both systems is similar to that called for in oxide fuels and matches that obtained in earlier work with UO_2/ThO_2, using a larger Lödige mixer and a continuous ribbon blender. Thus the model blender can be used on small-scale experimental blends and the results directly related to the behavior to be expected from full-scale equipment of high throughput. Author

N67-34341# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
DETERMINATION OF OXYGEN IN FLUORIDES AND REFRACTORIES BY INERT GAS FUSION
B. F. Greenfield and K. R. Hyde Mar. 1967 10 p refs
(AERE-R-4850) CFSTI: HC $3.00/MF $0.65

An apparatus for the rapid determination of oxygen in fluorides by inert gas fusion is described. The sample is reacted with carbon at a high temperature. The carbon monoxide is removed in a stream of high purity argon, oxidised to carbon dioxide which is collected in a trap at liquid nitrogen temperature, allowed to warm to room temperature and determined by measurement of its volume and pressure. The accuracy of the method has been established by using a uranium dioxide standard. Results are given for various types of fluoride melts. Author

N67-34349# Institut Franco-Allemand de Recherches, St. Louis (France).
QUALITATIVE ANALYSIS OF INCENDIARY MATERIALS ORIGINATING WITH TEMPERATURE AND RADIATION MEASUREMENT [DIE BEURTEILUNG VON BRANDSTOFFEN AUS TEMPERATUR- UND STRAHLUNGSMESSUNGEN]
H. W. Koch and F. Roessler 27 Sep. 1966 18 p refs In GERMAN Supported by Ger. Defense Min.
(ISL-T-21/66) CFSTI: HC $3.00/MF $0.65

Various incendiary materials are evaluated based on results of previously conducted temperature and radiation measurements. Considered are chiefly thermal conductivity and thermal radiation. An integral equation is given for deriving heat flux densities from temperature measurements at the boundary surface of incendiary material and support. Calculated results are compared with actual temperatures required to cause ignition in tests with several materials, and agreement was found to exist in all cases. Also examined are two extreme cases of radiation effect, one of which is a high-intensity flash radiation of the type caused by nuclear weapons, the other is of long duration and low intensity, i.e., similar to the effect of the sun or a magnifying glass. The more realistic radiation intensities, which lie between these two extremes, were not sufficient to cause ignition of the materials that were tested. Transl. by K.W.

N67-34350 Technische Hochschule München (West Germany).
INVESTIGATION OF ELECTROCHEMICAL REACTIONS ON THE SURFACE OF GERMANIUM IN CONTACT WITH DILUTED ELECTROLYTE SOLUTIONS [UNTERSUCHUNGEN UEBER ELEKTROCHEMISCHE REAKTIONEN AN DER OBERFLAECHE VON GERMANIUM IN KONTAKT MIT WAESSRIGEN ELEKTROLYTLOESUNGEN]
Wolfgang Mindt (Ph.D. Thesis) [1966] 79 p refs In GERMAN

The surface of a germanium electrode is coated with a hydroxide layer in case of anodic potentials and with a hydride layer in case of cathodic potentials. The transition between these two conditions was discussed as a surface-reducing reaction. Injection measurements and consumption of minority charge carriers during this reaction as well as an analysis of cyclic voltage curves indicate that the reaction takes place in two steps: in the first step a conducting electron is involved, in the second, a defect electron. The intermediate product of the reaction is a radical surface atom. Capacity measurements on self-conducting germanium electrodes showed that the position of the space charge zero point in the semiconductor varies between two extreme values in the electrode potential, depending on the pre-polarization of the electrods. The positions of the space charge zero point for the hydroxide and the hydride structures shift with increasing pH value to more negative potentials. The thermodynamic aspects of these processes are also discussed. The reduction of hydrogen peroxide was studied as an example of an electrochemical mechanism affected by the surface reaction on germanium. Studied as a second type of reaction was the anodic dissociation of germanium. Transl. by K.W.

N67-34358# California Univ., Berkeley. Lawrence Radiation Lab.
SOME CHEMICAL PROPERTIES OF ELEMENT 97

Joseph R. Peterson and Burris B. Cunningham 16 Jan. 1967 5 p refs Presented at the 13th Ann. Meeting of the Am. Nucl. Soc., San Diego, Calif., 11–14 Jun. 1967
(Contract W-7405-ENG-48)
(UCRL-17337; CONF-670602-4) CFSTI: HC $3.00/MF $0.65

An investigation of the chemical properties of berkelium is reported that includes solution absorption studies of the tripositive berkelium ion and the preparation and crystallographic characterization of the berkelium oxides, trichloride, oxychloride, and fluorides. Comparison of the lattice parameters of the berkelium compounds and other similar actinide compounds consistently show evidence of the so-called "actinide contraction." NSA

N67-34359# Kernforschungsanlage, Juelich (West Germany). Institut fuer Physikalische Chemie.
A COMPARISION OF TRI-N-OCTYLPHOSPHINE OXIDE AND TRI-N-OCTYLARSINE OXIDE AS EXTRACTION AGENT FOR TRIVALENT LANTHANIDES AND ACTINIDES [EIN VERGLEICH VON TRI-N-OCTYLPHOSPHINOXID UND TRI-N-OCTYLARSINOXID ALS EXTRAKTIONSMITTEL FUER DREIWERTIGE LANTHANIDE UND ACTINIDE]
A. J. F. Blair and H. Michael Dec. 1966 30 p refs In GERMAN; ENGLISH summary
(JUL-434-PC) CFSTI: HC $3.00/MF $0.65

Tri-n-octylarsine oxide was prepared by Gignard synthesis and its properties as extraction agent for trivalent lanthanides and actinides were compared with those of tri-n-octylphosphine oxide. The dependence of the extraction coefficients of the ions Am^{3+}, Cm^{3+} and Pm^{3+} from the concentration of the extraction agent, of nitric acid, and of lithium nitrate was measured. The synergic effects which occur upon extraction with mixtures of TLA with TOPO or TOASO were investigated. It was found that the properties of TOASO as extraction agent are very different from those of TOPO. TOASO is a stronger base than TOPO, and its extraction properties are comparable with those of trilaurylamine. Author

N67-34378 Technische Hochschule München (West Germany).
ON THE REDUCTION AND OXIDATION MECHANISMS OF ACRIDINES AND ACRIDANES AT NORMAL AND LOW TEMPERATURES [UEBER DIE REDUKTIONS- UND OXYDATIONSMECHANISMEN VON ACRIDINEN UND ACRIDANEN BEI NORMALEN UND TIEFEN TEMPERATUREN]
Juergen Thies (Ph.D. Thesis) [1966] 23 p refs In GERMAN

The usefulness of classical chemical methods is limited for studying the unstable intermediate products of the photoreaction of acridines and acridanes due to the short lifetime of these substances. In this study it was attempted to investigate characteristics and structure through the combined use of electron spin resonance, flash spectroscopy, and ultraviolet spectroscopy at low temperatures. Developed for this study were a thermostat for the ultraviolet spectroscopy at low temperatures and apparatus for oxygen dosimetry and degassing in order to measure the effect of the dissolved oxygen on the reactions. Particularly close attention was given to those acridines and acridanes whose photoreduction or photooxidation was to proceed through identical semiquinone phases. Since the addition or separation of hydrogen atoms during the reaction was to produce the iodine, the photoreaction was examined (1) at room temperature, (2) at −160°C, and (3) below −180°C; at (1), addition and separation were possible, the reaction was very fast; at (2), addition and separation were possible, reaction was slow; and at (3), with the solvent frozen solid, separation only was possible. Transl. by K.W.

N67-34383# United Kingdom Atomic Energy Authority, Dounreay (Scotland). Experimental Reactor Establishment.
THE SEPARATION OF NEODYMIUM FOR THE DETERMINATION OF THE BURN-UP OF NUCLEAR FUELS
D. J. Savage and J. L. Drummond [1967] 12 p refs
(TRG-1496(D) CFSTI: HC $3.00/MF $0.65

A single column anion exchange procedure using methanol/water/nitric acid solutions is described for the separation of neodymium. It is suitable for the measurement of the burn-up of irradiated nuclear fuel solutions using a mass spectrometric isotope dilution determination of the neodymium isotopes. The effect of variations in experimental conditions is studied, to determine the robustness of the method and the tolerable limits of variation. The resulting method is simple, robust and relatively rapid. It gives results for burn-up with a coefficient of variation of better than 2%. Author

N67-34403# Technische Hochschule München (West Germany).
ASYMMETRIC SYNTHESIS IN THE REACTION OF 2-TRIFLUORMETHYL-PSEUDOOXOYOLONES-(5) OR OXO-YOLONES WITH L-AMINO ACID ESTERS [ASYMMETRISCHE SYNTHESE BEI DER REAKTION VON 2-TRIFLUOMETHYL-PSEUDOOXAYOLONEN-(5) ODER OXAZOLONEN-(5) MIT L-AMINOSAEUREESTERN]
Francisco Xavier Barocio de la Lama (Ph.D. Thesis) [1968] 70 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

N-acyldipeptide esters are produced during the reaction of oxazolones-(5) with amino acid esters, and it was to be determined whether or not an asymmetric synthesis occurs during the catalysis of the oxazolone ring with optically active amino acids. It is shown that primarily D-L-diastereo isomers are formed during the reaction of oxazolones-(5) with l-amino acid esters. Transl. by K.W.

N67-34406# Argonne National Lab., Ill.
THE PREPARATION OF URANIUM MONOCARBIDE BY REACTION IN A LIQUID–METAL MEDIUM
E. J. Petkus, T. R. Johnson, and R. K. Steunenberg Mar. 1967 33 p refs
(Contract W-31-109-ENG-38)
(ANL-7301) CFSTI: HC $3.00/MF $0.65

A method of producing UC by direct combination of the two elements is described. A liquid Zn–Mg alloy medium is used to promote the reaction between dissolved U and suspended C. Agitation of the melt promotes intimate contact between the reactants and allows the reaction to proceed at 700 to 800°C. NSA

N67-34419 Joint Publications Research Service, Washington, D. C.
RULE FOR ESTIMATING CHEMICAL DISPLACEMENT OF PROTONS IN A DOUBLE-BOND
C. Pascual 28 Jun. 1967 9 p refs Transl. into ENGLISH from Helv. Chim. Acta (Basel), v. 49, no. 21, 1966 p 164–168
(JPRS-41595; TT-67-32228) CFSTI: $3.00

A rule is given for estimating chemical displacement of protons in olefinic systems using additive increments for the substituents. The calculated displacements agree with experimental values with a standard deviation of 0.15 ppm (1,070 measurements). Author

N67-34436# Atomic Weapons Research Establishment, Aldermaston (England).
AN ASSESSMENT OF ATOMIC FLUORESCENCE SPECTROMETRY AS A METHOD OF TRACE ANALYSIS
G. I. Goodfellow Jan. 1967 23 p refs
(AWRE-O-87/66) CFSTI: HC $3.00/MF $0.65

Resonance fluorescence radiation was measured on a monochromator consisting of a medium spectograph with a single slit direct reading head. The signals from a photomultiplier in the

head were amplified by a dc unit and displayed on a 0 to 10 mV chart recorder. Where background emission from the flame became significant an ac amplifier, tuned to a mechanical chopper placed between the irradiation source and the flame, was used. Spectral metal vapor discharge tubes and an experimental form of electrodeless discharge tube excited by magnetron generated microwaves of 2425 Mc/s served as irradiation sources. Factors influencing sensitivity were studied including irradiation of the flame and flame parameter characteristics. Inter-element interference effects were also examined. The results obtained by addition of certain elements to zinc, cadmium, and copper are described. The effect of addition of alkali metals was stressed since the low excitation potentials in this group markedly alter the temperature of the flame source. It is concluded that atomic fluorescence spectroscopy techniques hold good potential for simplified trace analysis. E.C.

N67-34461# Rocky Flats Div., Dow Chemical Co., Golden, Colo.

GAS CHROMATOGRAPHIC INVESTIGATIONS FOR THE DETERMINATION OF FLUORINE AND OXYGEN IN MIXTURES

Robert P. De Grazio and Robert G. Auge 12 Apr. 1967 15 p refs

(Contract AT(29-1)-1106)

(RFP-880) CFSTI: HC $3.00/MF $0.65

Various methods were investigated for the determination of fluorine and oxygen in gas mixtures by gas chromatographic techniques. The technique found to be successful involves the quantitative conversion of fluorine to chlorine by the reaction with sodium chloride and the subsequent separation and detection of chlorine and oxygen. Author (NSA)

N67-34488# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.

CONTRIBUTION TO THE STUDY OF HYDROGENATED AND OXYGENATED IMPURITIES IN LIQUID SODIUM

Gerard Naud 1966 50 p refs Transl. into ENGLISH of CEA-2583

(TRG-552(C); CEA-2583) CFSTI: HC $3.00/MF $0.65

Analytical methods for determining the levels of oxygen, hydrogen in the free state or in the form of hydride; total hydrogen; and sodium hydride, hydroxide and oxide impurities in liquid sodium are described. The kinetics of the reaction between hydrogen and liquid sodium between 150°C and 250°C was studied. Tests performed allowed the preparation of sodium samples with known levels of dissolved hydride or hydrogen, and also verified that, under experimental conditions, the variation in rate of reaction as a function of temperature follows the Arrhenius law with a corresponding activation energy of 16.5 kcal. It was also shown that the thermal decomposition of sodium hydride in liquid sodium and under a secondary dynamic vacuum is a first-order reaction. This property was demonstrated between 280°C and 310°C, and for hydrogen levels of the order of several ppm. In the reaction $NaOH+2Na \rightarrow Na_2O+NaH$, it was shown that the reaction appears to be of the first order, its threshold temperature being about 300°C. The parasitic evolution of gas in experiments when sodium is in contact with Pyrex glass was verified. Experiments showed that the attack of Pyrex glass by liquid sodium begins at about 150°C and is accompanied by evolution of hydrogen. Observation of the kinetics of the formation of hydrogen led to the formation of a hypothesis of a reaction between the sodium and the –OH groups which may be present in the glass. S.C.W.

N67-34525# National Bureau of Standards, Washington, D. C. Electrochemical Analysis Section.

ELECTROCHEMICAL ANALYSIS: STUDIES OF ACIDS, BASES, AND SALTS BY EMF, CONDUCTANCE, OPTICAL, AND KINETIC METHODS, JULY 1, 1965–JUNE 30, 1966

Roger G. Bates, ed. 6 Sep. 1966 113 p refs

(NBS-TN-400) GPO: $0.55

Brief summaries of the several lines of work now under way are given. The main areas include the study of acidity measurement in water, deuterium oxide, and methanol–water solvents, along with the development and certification of standard reference materials with which acidity scale in these media can be defined. Solvent effects and isotope effects are being studied, and equilibrium data for certain systems of analytical interest have been obtained. Progress on a conductometric method for determining traces of water is reported, and the thermodynamic properties of some salt mixtures have been measured by a vapor pressure method. Kinetic methods for trace analysis have been examined, and a new lot of potassium hydrogen phthalate has been certified for use as an acidimetric standard. Author

N67-34560# Reactor Group, United Kingdom Atomic Energy Authority, Culcheth (England). Reactor Materials Lab.

GAS HYDRIDING ZIRCALOY-2 AT 400°C

J. Winton and M. Farrow [1967] 22 p refs

(TRG-1446(C)) CFSTI: HC $3.00/MF $0.65

An account is given of experiments which attempted to develop a method for introducing large quantities of hydrogen into Zircaloy-2 samples at a temperature of 400°C over a period of about 3 days. Surface hydride layers could usually be avoided if the rate of ingress of hydrogen was kept below 10 ppm/h, although other factors such as surface contamination were also found to encourage layering. The rate of entry of gaseous hydrogen into the zirconium surface is controlled largely by the structure and constitution of a thin oxide skin, but no means of reproducibly controlling the permeation characteristics of the film was found. This difficulty can be avoided by chemically destroying the oxide film in the hydriding furnace with CCl_4 vapour and then metering hydrogen into the furnace at a controlled rate. Author

N67-34567 Commissariat a l'Energie Atomique, Saclay (France). Departement des Radioelements.

RECUPERATING CAESIUM 137 BY PHOSPHOTUNGSTATE PRECIPITATION [RECUPERATION DU CAESIUM 137 PAR PRECIPITATION DE PHOSPHOTUNGSTATE]

J. Lefevre and C. Aubertin Brussels, EURATOM, May 1967 33 p refs In FRENCH; ENGLISH summary

(Contract EURATOM-025-62-10 RISF)

(EUR-3473.f)

The full process is described, as tested on inactive synthetic fission products in a semi-industrial scale pilot plant equipped with a centrifuging settler. The process was laboratory-developed with the aid of radioactive tracers, and was designed to afford the maximum restriction of caesium waste in the effluents. With this object a certain number of internal recyclings and an initial decontamination stage were planned and tested, and these admit a waste value in the effluents of less than 10^{-4} of the treated caesium. These conditions weigh heavily on the installing of this exceptionally simple chemical process. Author

N67-34572# British Columbia Univ., Vancouver. Dept. of Chemistry.

ATOM RECOMBINATION. PART I: HALOGEN ATOMS. PART II: SINGLET MOLECULAR OXYGEN Final Scientific Report, Jan. 1963–Apr. 1967

E. A. Ogryzlo Apr. 1967 33 p refs

(Grants AF-AFOSR-158-63; AF-AFOSR-158-65)

(AFOSR-67-1290; AD-653611) CFSTI: HC $3.00/MF $0.65

The research includes an investigation of the complex mechanisms involved in the recombination of certain atoms, halogens and oxygen. Electrical discharge produced the atoms and their concentration was measured as a function of time by a titration

procedure and with an isothermal calorimetric atom-detector. Major conclusions resulting from this investigation are: (1) Excited oxygen molecules can be prepared with an electrical discharge. Kinetic studies with these species are possible since the concentration of species as a function of time can be measured calorimetrically or spectroscopically. (2) The excited molecules of O2 are formed in an energy disproportionation process. (3) Two molecules of oxygen can combine their energies and emit it as a single photon. The temperature dependence of the rate constant indicates that the emission comes from a colliding pair of molecules. (4) O2 can dissociate ozone. (5) The dissociation of molecular iodine atoms with the oxygen molecule was observed. Author (TAB)

N67-34593# International Union of Pure and Applied Chemistry, Basle (Switzerland). Commission on High Temperatures and Refractories.
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND PLASMAS
L. Brewer, comp. (Calif. Univ., Berkeley) 30 Jun. 1967 33 p refs Prepared in Cooperation with Natl. Bur. of Std.
(Rept.-23) Available from Natl. Bur. of Std., Washington, D. C.

This bibliography lists 148 titles chiefly concerned with spectroscopy of interest to high-temperature chemistry, and 129 titles which deal mainly with reactions between gases and condensed phases. The majority of the works was published in 1966. K.W.

N67-34595*# Rocketdyne, Canoga Park, Calif.
PROPERTIES OF NONAQUEOUS ELECTROLYTES Quarterly Report, 20 Mar.–19 Jun. 1967
Rudolf Keller, James N. Foster, John F. Hon, Otto F. Kalman, and Jack M. Sullivan 19 Jul. 1967 80 p refs
(Contract NAS3-8521)
(NASA-CR-72277; R-6754-4; QR-4) CSCL 07D

Studies of aprotic electrolytes based on three solvents, propylene carbonate, dimethyl formamide and acetonitrile, were continued. Only characterized components were used to prepare the electrolyte solutions. Structural studies of electrolytes containing tetramethylammonium hexafluorophosphate, lithium perchlorate cupric chloride, and aluminum chloride with or without lithium chloride added were performed by nuclear magnetic resonance. The physical property studies included measurements of viscosities, solubilities, conductances, and transference numbers of a number of electrolytes. Author

N67-34614 Joint Publications Research Service, Washington, D. C.
A FLOW APPARATUS WITH GLASS ELECTRODES. ON THE ACIDITY CONSTANT OF TRUE CARBONIC ACID AND ITS RATE OF DEHYDRATION
Juerg Meier and G. Schwarzenbach 28 Jun. 1967 17 p refs Transl. into ENGLISH from Helv. Chim. Acta (Basel), v. 40, no. 105, 1957 p 907–917
(JPRS-41613; TT-67-32246) CFSTI: $3.00

A flow apparatus makes possible the mixing of comparatively large volumes (1 lit/min) of 2 reactants in solution. Mixing is completed within 10^{-2} sec and the first pH-determination of the mixture is then made utilizing a glass electrode. The acidity constant of true carbonic acid (H_2CO_3) could thus be determined by mixing $KHCO_3$ with HCl and the result is in complete agreement with data from high-voltage conductivity measurements. The rate of dehydration of H_2CO_3 was obtained from the pH-values 5×10^{-2}, 27×10^{-2} and 54×10^{-2} seconds after mixing. It was shown that this dehydration is not simply a first-order reaction. A quadratic term is also important within the first quarter of a second. Author

N67-34617 Aeronautical Research Labs., Melbourne (Australia).
THE DETERMINATION OF ARSENIC IN COPPER-ARSENIC ALLOYS BY ATOMIC ABSORPTION SPECTROSCOPY
L. Wilson Jun. 1966 11 p ref
(ARL/MET-42)

The determination of arsenic in copper-arsenic alloys has been carried out by atomic absorption spectroscopy. An air-acetylene flame has been shown to be satisfactory even at the low wavelengths (<2000 Å) of the arsenic resonance lines. The method is rapid and accurate and is not influenced by the presence of large amounts of copper. Author

N67-34639 European Atomic Energy Community, Ispra (Italy). Chemistry Dept.
COMPUTER PROGRAM FOR ACTIVATION ANALYSIS WITH GERMANIUM LITHIUM DRIFTED DETECTORS
G. Guzzi, J. Pauly, F. Girardi, and B. Dorpema Brussels, May 1967 43 p refs
(EUR-3469.e)

A computer program developed for activation analysis problems is presented. This program is based on the measurement of photopeak surfaces of complex gamma spectra obtained by means of Ge(Li) detectors. Possible interferences from radioisotopes are evaluated, but not corrected. The program has been used routinely for the determination of radioelements in biological specimens. Author

N67-34666 Royal Aircraft Establishment, Farnborough (England).
THE THERMAL DEGRADATION OF POLYPHENYLENE- AND PERFLUOROPOLYPHENYLENE SULPHIDES
N. S. J. Christopher, J. L. Cotter, and G. J. Knight Dec. 1966 11 p refs
(RAE-TR-66400)

The products of the thermal degradation in vacuo of polyphenylene- and perfluoropolyphenylene sulphides provide evidence for the occurrence of chain breaking and radical transfer processes, and imply that a large degree of crosslinking occurs during degradation. Author

N67-34677# Iowa State Univ. of Science and Technology, Ames.
RECOIL CHEMISTRY OF CARBON-11 IN C_6 HYDROCARBONS. FRAGMENTATION, AND STABILIZATION
Gary Lew Jewett (Ph.D. Thesis) Feb. 1967 80 p refs
(Contract W-7405-ENG-82)
(IS-T-118) CFSTI: HC $3.00/MF $0.65

The chemical behavior of carbon-11 atoms produced by the $^{12}C(\gamma,n)^{11}C$ process was studied by the use of radio-gas chromatography. The compounds isopentane, n-pentane, pentene-1, cyclopentane, cyclopentene, and benzene were irradiated with 70-MeV bremsstrahlung and the yields of labeled products containing one to six carbon atoms were determined. In the cyclopentene system, the yields of methane, ethane, ethylene, and acetylene were studied as a function of dose. These yields did not vary, indicating that the cyclopentene may have been acting as a scavenger. The yields of products in unscavenged systems did not total 100 percent, and the total yields were less for unsaturated than for saturated systems. In the isopentane system, part of the missing activity was found as products containing eleven carbon atoms. This indicated that in some cases the carbon atom reacts with two molecules of the parent compound. The only time a strict statistical distribution of products was found was in the n-pentane plus iodine system. The absolute yields of n-hexane: 2-methylpentane: 3-methypentane were found as 6.69:4.17:1.98 with the expected ratios being 6:4:2. The product distributions are discussed in terms of the insertion reactions of ^{11}C, ^{11}CH, and $^{11}CH_2$ NSA

N67-34728# California Univ., Livermore. Lawrence Radiation Lab.
SOLUTION DENSITIES OF SODIUM BROMIDE AS A FUNCTION OF TEMPERATURE AND ANHYDROUS SALT CONTENT
William L. Robison and Michael J. P. Weston 4 May 1967 158 p ref
(Contract W-7405-ENG-48)
(UCRL-50257) CFSTI: HC $3.00/MF $0.65

The International Critical Tables give the solution densities of sodium bromide as a function of anhydrous salt content at intervals of 2% and as a function of anhydrous salt content at invervals of 10°C. A Lagrange polynomial generalized for two variables and requiring a double interpolation was used in conjunction with the data from these tables to generate tables with 0.1% intervals (from 1.00 to 28.00%) for anhydrous salt content and 0.1°C (from 0 to 36.3°C) for temperature. The density range is from $\rho = 1.00118$ to $\rho = 1.27017$. Author (NSA)

N67-34730*# National Aeronautics and Space Administration, Washington, D. C.
RESEARCH ON THE DERIVATIVES OF PYROMELLITIC AND CUMYLIC ACIDS [RECHERCHES SUR LES DERIVES DES ACIDES CUMIDINIQUES ET PYROMELLITHIQUE]
H. de Diesbach and G. Zurbriggen Aug. 1967 13 p refs Transl. into ENGLISH from Helv. Chim. Acta (Basel), v. 8, 1925 p 546–557
(NASA-TT-F-11200) CFSTI: HC $3.00/MF $0.65 CSCL 07C

Preparation and identification of the derivatives of cumidinic and pyromellitic acids, including analogs of phthalide and phthalimide, are discussed. As starting product, isomeric cumidinic acids, prepared from dibromoxylenes, were used instead of the conventional pyromellitic acids. Formulas and preparative methods are described, with yields for the various derivatives. Preliminary results were obtained by introduction of one and two bromine atoms into each methyl group, yielding a series of isomeric derivatives (which are given). Author

N67-34748 Technische Hochschule Munchen (West Germany).
ON THE APPLICATION OF AROMATIC O-DIAMINES IN CHEMICAL-TECHNOLOGICAL SELENIUM INVESTIGATIONS IN GROUND AND SURFACE WATERS [ZUR VERWENDUNG AROMATISCHER O-DIAMINE BEI CHEMISCH-TECHNOLOGISCHEN SELENUNTERSUCHUNGEN IN GRUND- UND OBERFLAECHENWAESSERN]
Lothar Feiler (Ph.D. Thesis) 22 Nov. 1966 126 p refs In GERMAN Supported in part by Ger. Res. Soc.

The use of piazselenoles (2,1,3-benzo(naphtho)selenodiazole) in the polarographic and spectrophotometric analyses of water to detect small amounts of selenium was investigated. A method for applying such analyses to mineral-containing water or organically contaminated water was developed. In addition to polarography and spectrophotometry, the method is based on addition and separation of the selenium by means of precipitation, ion exchange, extraction, and distillation. The polarographic method is effective for the range from 0.1 to 25 μg/ml, the spectrophotometric method for the range 0.001 to 0.25 μg/ml. Mineral water, potable water, industrial water, and water from various thermal springs were successfully analyzed with this method. Emphasis was placed on analyzing the presence and behavior of selenium in potable water obtained from lakes, rivers, and ground water. The effect of industrial pollution on the selenium content of river and rain water was studied. Ground filtration, chlorination, iron removal, activated carbon filtration, and flocculation were closely studied for their effects on selenium content of potable water. Transl. by K.W.

N67-34797# European Atomic Energy Community, Geel (Belgium). Central Bureau for Nuclear Measurements.
ACCURATE DETERMINATION OF THE IRIDIUM IN AN ALUMINUM–2.5% IRIDIUM ALLOY [LA DETERMINATION PRECISE DE L'IRIDIUM DANS UN ALLIAGE ALUMINIUM–2,5% IRIDIUM]
A. Brueck Brussels, May 1967 14 p refs In FRENCH; ENGLISH summary
(EUR-3468.f)

The determination of iridium in an aluminum–2.5% iridium alloy is decreased. Iridium is precipitated with mercapto–2 benzothiazol and the interference of aluminum is eliminated with tartaric acid. Iridium is finally weighed in the metallic form. The coefficient of variation is 0.45% (12 determinations). The method can be applied, with the given precision, to concentrations greater than 2% iridium in aluminum. Author

N67-34836# Technische Hogeschool, Eindhoven (Netherlands).
DIFFUSION AND SURFACE REACTIONS OF SINGLET EXCITONS IN ANTHRACENE
Berend Jan Mulder (Ph.D. Thesis) 1967 43 p refs
CFSTI: HC $3.00/MF $0.65

Reported is a study of those aspects of the photoconduction and the fluorescence of anthracene and other aromatic hydrocarbons that can be interpreted in terms of the diffusion of singlet excitons and their annihilation at the crystal surface. Investigated is the extent to which the simple diffusion model is valid. A calculation is made of the contribution from the reabsorption of fluorescent light to the concentration of excitons at the illuminated surface. Using the exciton-diffusion model, an analysis was made of excitation spectra for the following three types of effects observed on anthracene: (1) the sensitized fluorescence emitted by very small amounts of the dye rhodamine B adsorbed from aqueous solutions on the surface of the crystal; (2) the photoconduction of crystals in a sandwich cell with aqueous electrodes; and (3) the fluorescence of crystals in contact with aqueous solutions of various compositions. The values of the exciton diffusion length obtained by the three methods are compared. Also studied was the diffusion of excitons in various crystallographic directions in anthracene, and the exciton diffusion in doped anthracene crystals and in crystals of some other aromatic hydrocarbons. The nature of the surface reactions of excitons was investigated by varying the composition of the aqueous solution in contact with anthracene crystals. Observed deviations from the exciton-diffusion model are discussed. S.C.W.

N67-34876 Joint Publications Research Service, Washington, D. C.
IONITES
A. B. Pashkov, K. M. Saldadze, and B. Ya. Kel'man 1 Jul. 1967 16 p Transl. into ENGLISH of the Title "Ionity" Moscow, "Khimiya" Publishing House, 1965 p 3–15
(JPRS-41677; TT-67-32309) CFSTI: HC $3.00

Described are chemical physical properties of cationites and anionites used in industrial applications; specifications of ionites and anionites which have been prepared for industrial production; and chemical and physical properties of heterogeneous cationite and anionite membranes. S.C.W.

N67-34880 Technische Hochschule Munchen (West Germany). Der Fakultaet fuer Maschinenwessen und Elektrotechnik.
TRANSMETALLIC REACTION ON METALLIC QUATERNARY AMMONIUM SALTS AND THE PENTAPHENYL COMPOUNDS OF ELEMENTS OF GROUP V [TRANSMETALLIERUNGSREAKTIONEN AN METALLIERTEN QUARTAEREN AMMONIUMSALZEN UND DEN PENTAPHENYLVERBINDUNGEN DER ELEMENTE DER FUENFTEN HAUPTGRUPPE]
Juergen Paetsch (Ph.D. Thesis) 1967 74 p refs In GERMAN

Chemical reactions such as the transmetallic reaction with diphenyl mercury and peroxygenation with elemental oxygen as well as infrared and nuclear resonance spectroscopy on the reaction product of tetramethyl ammonium bromide with lithium–organic compounds established that this is structurally a metallic ammonium salt, not an -ylide. Isotope experiments showed that an intramolecular lithium–hydrogen exchange occurs in this reaction. Using tritium-marked phenyllithium in kinetic studies of the transmetallic reaction of the pentaphenyl compounds of phosphorus, arsenic, antimony, and bismuth has shown for Ph_5P and Ph_5As that due to steric causes, the formation of the unstable -ate-complex intermediate phase is determining the speed. Ph_5Sb and Ph_5Bi react faster to the -ate-complex. The complex is very constant in case of Ph_5Sb, and no further reaction occurs. In case of Ph_5Bi the complex is somewhat unstable, which is shown by a complete exchange of the phenyl group. Transl. by K.W.

N67-34888 Central Lab. for Radiological Protection, Warsaw (Poland).
ANION EXCHANGE BEHAVIOUR OF ALKALINE EARTH ELEMENTS IN DIOXANE–WATER–HYDROCHLORIC-ACID AND DIOXANE–WATER–PERCHLORIC ACID MEDIA [ANIONOR A WYMIANA PIERWIASTKOW YIEM ALKALICYNYCH W OSRODKACH DIOXAN–WODA–KWAS SOLNY I DIOXAN–WODA–KWAS NADCHLOROWY]
W. Czosnowska 1967 12 p refs
(CLOR-62-D)

Alkaline earth cations are not taken up into strongly basic anion exchange resins such as Dowex 1, from aqueous mineral acid solutions. However, uptake of these ions does occur when the water is replaced by certain organic solvents, e.g., dioxane, acetone, ethyl alcohol. Experiments with dioxane–water–mineral acid mixtures, to be reported in this report, show the important influence of the anion present in these systems on the distribution of the alkaline earth cations. In particular, a strong difference between systems containing hydrochloric acid and those containing perchloric acid was observed. Furthermore the distribution of water and mineral acid in such systems was studied and an interesting correlation between uptake of water and of mineral acid into the resin was found. Author

N67-34901# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
HIGH RESOLUTION AUTORADIOGRAPHY
R. A. Ploc Jun. 1967 15 p refs
(AECL-2704) CFSTI: HC $3.00/MF $0.65

An assessment of high resolution autoradioactive sources to within 500 Å to 600 Å should be possible, for certain metallurgical applications. These applications might include the location of impurity atom clusters at grain boundaries or dislocations; the location of precipitates of substances which have an atomic number similar to that of the matrix; the identification of diffusion paths; preferential absorption or adsorption; segregation of impurities and the role of specific ions in phenomena such as stress corrosion (e.g., the segregation of hydrogen at crack tips), or fatigue. Author

N67-34907 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
EFFECT OF TEMPERATURE ON RADIOCHEMICAL SEPARATION OF ALKALI METALS ON SULFONIC AND PHENOLSULFONIC ION EXCHANGES [WPLYW TEMPERATURY NA RADIOCHEMICZNE ROZDZIELANIE METALI ALKALICZNYCH NA JONITACH SULFONOWYCH I FENOLOSULFONOWYCH]
Rajmund Dybczynski 1967 23 p refs
(INR-809/VII/C)

The separation of alkali metals on Amberlite IR-120, and phenolsulfonic ion exchanger MK-3, were investigated at various temperatures. For both resins, separation factors of alkali metals decrease with the increase in temperature. Unexpectedly, the height of theoretical plate was found to increase with the rise in temperature. Phenolsulfonic resin exhibited high selectivity towards cesium, and may be used for the isolation of cesium traces from macro amounts of lighter alkali metals. The irreversible loss of this high selectivity was observed at elevated temperatures. Author

N67-34948# Aeronautical Research Labs., Melbourne (Australia).
THE PREPARATION OF THE NITRIDES OF CHROMIUM
T. Mills and T. G. Hill Sep. 1966 10 p
(ARL/MET-44) CFSTI: HC $3.00/MF $0.65

The two nitrides of chromium, Cr_2N and CrN, have been prepared in a compact form by nitriding chromium powder. The products sintered sufficiently for them to be ground and machined to make specimens for further studies. Contamination with oxygen was eliminated by use of titanium and/or chromium getters suitably placed in the reaction chamber. Author

N67-34968# Oak Ridge National Lab., Tenn. Reactor Chemistry Div.
COMPATIBILITY OF PYROLYTIC-CARBON COATED FUEL PARTICLES WITH WATER VAPOR
C. M. Blood and L. G. Overholser Nov. 1966 30 p refs
(Contract W-7405-ENG-26)
(ORNL-4014) CFSTI: HC $3.00/MF $0.65

The oxidation of various lots of coated fuel particles by water vapor was studied at 1000°C using He–water vapor mixtures having partial pressures of ≈4.5, 46, and 567 torr and a total pressure of 1 atm. Rates of reaction of water vapor with pyrolytic C coatings were determined from weight losses and, in a few instances, from flow rates and analyses of effluent gases. Surface area measurements of coated fuel particles were made before and after oxidation by water vapor. Incidence of failure of coatings was determined from the amount of U leached out of the oxidized coated fuel particles. Surface area development by oxidation with water vapor could not be correlated with reaction rates. The effects of partial pressure of water vapor on the reaction rates also were obscure. Experiments made in graphite containers indicated that graphite can protect the coated fuel particles from oxidation by water vapor. Photomicrographs of a number of oxidized fuel particles are included. Author (NSA)

N67-34993# Sandia Corp., Livermore, Calif.
EFFECT OF SOME VARIABLES ON THE THROWING POWER AND EFFICIENCY OF COPPER PYROPHOSPHATE SOLUTIONS
John W. Dini, Herman R. Johnson, and John R. Helms Apr. 1967 30 p refs Presented at the Am. Electroplaters Soc. Natl. Conv., Dallas
(Contract AT(29-1)-789)
(SLC-DC-67-22; CONF-670606-1) CFSTI: HC $3.00/MF $0.65

A study of some of the factors involved in Cu pyrophosphate plating was undertaken to determine the effects of these factors on throwing power and cathode efficiency. Plating-bath constituents investigated included Cu, pyrophosphate, NH, ortho phosphate, and inorganic salts. The effects of variations in pH, temperature, agitation, and current density were also investigated. All throwing power data were obtained in Haring cell modified to provide controlled agitation at both cathodes. This resulted in deposits much more representative of those produced in industrial baths. Author (NSA)

N67-35005 Ministry of Technology, London (England). Technical information and Library Services.
UNIFORMITY IN THE EXECUTION OF THE ABEL HEAT TEST WITH NITROOLYCERINE [EINHEITLICHE DURCHFUEHRUNG DES ABEL-TESTES BEIM PULVER-NITROGLYCERIN]
M. Berkovic Jul. 1967 11 p refs Transl. into ENGLISH from Explosivstoffe (Leipzig), v. 11, no. 9, 1963 p 148–188
(TIL/T-5727)

It is shown that uniformity in the execution of the Abel test is a practical proposition and the effect of the many confusing factors which influence the results of the Abel Heat Test is clarified, so that finally the test can become an accurate measure of the stability of nitroglycerin and a reliable industrial check. Author

N67-35010# United Kingdom Atomic Energy Authority, Warrington (England). Reactor Group.
THE DEVELOPMENT OF IMPREGNATED CHARCOALS FOR TRAPPING METHYL IODIDE AT HIGH HUMIDITY
D. A. Collins, L. R. Taylor, and R. Taylor 1967 45 p refs
(TRG-1300(W)) HMSO: 5s 6d

Methyl iodide can be present in releases of iodine from irradiated fuel and at high humidity most activated charcoals will not provide efficient permanent retention of the methyl iodide. Impregnation of activated charcoal with certain amines or inorganic halides has been found to improve the retention of methyl iodide at high humidity. The best results are given by triethylenediamine or potassium iodide supported on 207B charcoal. The behavior of these two impregnated charcoals has been examined in more detail. Design data are presented in the form of a linear relationship between log DF and stay-time in the charcoal bed, and a predicted allowance for ageing of charcoals exposed to a continuous flow of air. The performance during and after exposure to steam at high temperature has been measured. Author

N67-35033# Idaho Nuclear Corp., Idaho Falls. National Reactor Testing Station.
D MATRIX: A COMPUTER PROGRAM FOR CALCULATING VALENCE FORCE COORDINATES IN TERMS OF ATOM DISPLACEMENTS OF A MOLECULE OR CRYSTAL
J. K. Boyter and H. L. McMurry May 1967 46 p refs
(Contract AT(10-1)-1230)
(IN-1076) CFSTI: HC $3.00/MF $0.65

A Fortran program written for the IBM 7040 which calculates the valence force coordinates of the valence force potential function in terms of the atom displacements, and mass adjusted displacements in a molecule or crystal is described. The input data is explained with illustrative applications given for propane and diamond. Two other test examples are also given. Author

N67-35085# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE MEASUREMENT OF HYDROGEN SULFIDE IN THE ATMOSPHERE
Manfred Buck and Hermann Gies *In its* Hyg. Effects and Control of Dusts, Fogs, Gases, Vapors, Radioact. Particles 1966 p 27–33 refs (See N67-35081 20-34)

Sorption of hydrogen sulfide, associated with silver sulfide formations, occurs in sorption tubes. Hydrogen sulfide, liberated from it by subsequent treatment with acid, is then determined according to the molybdenum blue method. In the range of MIK values the standard deviation equals ± 5% rel. The detection limit lies below the detectable intensity of the H_2S smell. Since no SO_2 is absorbed in the H_2S sorption tube, SO_2 determination can be carried out simultaneously with H_2S measurement using the same air sample according to the silical gel or TCM method. Author

N67-35086# Israel Program for Scientific Translations, Ltd., Jerusalem.
ODOR THRESHOLDS OF SOLVENTS FOR ASSESSMENT OF SOLVENT ODORS IN THE AIR
Johannes May *In its* Hyg. Effects and Control of Dusts, Fogs, Gases, Vapors, Radioact. Particles 1966 p 34–38 refs (See N67-35081 20-34)

Approximate detection limits of 37 solvents were determined and values for concentrations are given at which a distinct odor is produced. Investigation of mixed odors was undertaken. Quantitative analyses of vapor concentrations of solvent mixtures were carried out by means of chromatographs up to the detection limit. Author

N67-35118# Ceskoslovenska Akademie Ved. Rez. Ustav Jaderneho Vyzkumu.
CHEMICAL ANALYSIS OF URANIUM ALLOYED WITH IRON AND ALUMINUM [CHEMICKA ANALYSA URANU S NIZKYM OBSAHEM ZELEZA A HLINIKU]
J. Zocek Nov. 1966 28 p refs In CZECH; ENGLISH summary
(UJV-1681)

The spectrophotometric determination of a small amount of Fe and Al in low-alloyed uranium alloys is described. Two variations of the analysis were developed: the simultaneous determination of both elements and determination of each element separately. Furthermore the analysis of the master U–Al alloy used for alloying is described. This process is used also to test standard Al solutions. To eliminate elements disturbing the determination of Al when hydroxyquinoline is used, 2-methyl-8-hydroxyquinoline was tested. Author (NSA)

N67-35127# Babcock and Wilcox Co., Lynchburg, Va. Nuclear Development Center.
GEL-ADDITION PROCESS CHEMICAL STUDIES Quarterly Progress Report, Jul.–Sep. 1966
E. H. Dewell, comp. Mar. 1967 53 p refs
(Contract AT(30-1)-3714)
(BAW-3714-1; QR-1) CFSTI: HC $3.00/MF $0.65

Uranie gels were contacted with Pu in three valence states (III, IV, VI) in acid nitrate solution (pH approximately 0.5) and the uptake of Pu was measured for periods ranging from a few minutes to several hours. Pu(IV) seemed to be the most promising, since it combines a high uptake (about 20% U/U+Pu) with ease of preparation. However, all Pu–HNO_3 solutions are corrosive to UO_2; therefore, gel attrition measurements have received considerable attention. NSA

N67-35156# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
APPARATUS FOR DETERMINING GASES IN METALS BY VACUUM FUSION [APARATO PARA LA DETERMINACION DE GASES EN METALES POR FUSION EN VACIO]
Estanislao Zuzek and Juan G. Di Primio 1967 48 p refs In SPANISH
(CNEA-186) CFSTI: HC $3.00/MF $0.65

Methodology, instrumentation, and theoretical exposition are presented on an advanced vacuum-fusion apparatus for determining the presence of some gases in metals. Application is to sophisticated technological utilization of materials requiring the highest purity, since even minute quantities of gases affect the physical and mechanical properties of metals. A brief comparison is made of the macro (up to 20 g) and the semimicro (5 to 100 mg) methods. The determination of oxygen, hydrogen, and nitrogen was evaluated. Transl. by R.Ll.

N67-35198 Technische Hochschule München (West Germany). Der Fakultaet fuer Maschinenwesen und Elektrotechnik.
CATALYZED GAS FORMATION FROM LIQUID FUEL WITH WATER [KATALYTISCHE VERGASUNG VON FLUESSIGEN KRAFTSTOFFEN MIT WASSER]
Guido Kober (Ph.D. Thesis) Oct. 1965 90 p refs In GERMAN

Theoretically obtainable energy factors during carboration of various hydrocarbons with water were studied according to the formula $C_nH_m + n \times H_2O = n \times CO + (n + m/2) \times H_2$. Thermal and catalytic decomposition followed by catalytic carboration of the decomposition products by water vapor were described and an equilibrium calculation for heptane depicts the influence of temperature and water excess on the upper heating value of dry gases. Experimental results on technical hydrocarbon mixtures and lighter weight heating oils showed that about 30% of the maximum hydrocarbon heating values were translated into chemical energy by catalyzed gas formation. Transl. by G.G.

N67-35212# General Electric Co., Schenectady, N. Y. Research and Development Center.
OXYGEN CHEMISORPTION AND PENETRATION AT A NICKEL SURFACE
F. C. Tompkins (Imp. Coll. of Sci. and Tech.) and T. A. Delchar Sep. 1966 25 p refs
(Rept.-66-C-327)

A continuous recording (static capacitor) device was used to measure the surface potential changes occurring during oxygen chemisorption on clean nickel films. The kinetics of the incorporation process at 77° and 90°K are affected by the surface electric field formed by the oxygen–nickel double layer. Analysis of the kinetic curves, corrected for field effect, shows that the average charge per oxygen atom is 0.3 ± 0.04 of an electron charge. The experimental rate of incorporation is smaller, by a factor of approximately 10^{12}, than that calculated from the absolute rate equation using the experimental value of the activation energy of 1 kcal/mole. The calculated probability for this concerted motion is in agreement with the experimental value; the magnitude of the effective surface energy barrier is then evaluated at 7.3 ± 1 kcal/mole. At temperatures between 350° and 430°K, the kinetics of incorporation change, and their autocatalytic character corresponds to that of a nucleation and growth process. Author

N67-35215# Bureau of Mines, Reno, Nev. Metallurgy Research Center.
REACTION RATES OF THE TITANIUM–OXYGEN ALLOY SYSTEM AND TITANIUM CHLORIDES IN MOLTEN SODIUM CHLORIDE
Ernst K. Kleespies, J. Jackson, Jr., and T. A. Henrie Aug. 1967 17 p refs
(BM-RI-7005)

The rate of the heterogeneous reaction between titanium–oxygen solid solutions and titanium trichloride in molten sodium chloride was determined at high temperatures. In the alpha phase, the reaction rate decreases uniformly with the increasing concentration of oxygen. The gamma crystalline form of titanium (above 33 atomic percent oxygen) was much less reactive than the alpha phase, and the reaction rate approached zero at 50 atomic percent oxygen. The activation energy for the reaction of titanium–oxygen solution containing 22.8 percent oxygen was 11.7 kcal/mole of $TiCl_3$ as compared with 8.3 kcal/mole of $TiCl_3$ for pure titanium. Author

N67-35218# Atomic Energy Commission, New Brunswick, N. J.
ANNUAL PROGRESS REPORT FOR THE PERIOD JULY 1965 THROUGH JUNE 1966
C. J. Rodden Feb. 1967 102 p refs
(NBL-237) CFSTI: HC $3.00/MF $0.65

Results are reported on: spectrophotometric determination of Mo and W in B, ^{10}B scrap recovery, dissolution of powdered B for flame spectroscopic analysis, determination of some impurities in B using a direct-reading spectrograph, determination of B in stainless steel–boron alloys, determination of Na in B by fast-neutron activation, adaptation of dual-grating spectrograph to a direct reading instrument, design of transistorized high-sensitivity coulometric titrator, determination of rare earths in ore residues, analysis of uranium solutions by atomic absorption spectrometry, calibration of uranium foils by α–γ coincidence method, mass spectrometric isotopic analysis of U, preparation of spectrographic standards for Be, storage and shipment of $Pu(NO_3)_4$ standard solutions, spectrochemical determination of impurities in Pu, spectrophotometric determination of Fe in Pu, effect of ion exchange resin on potentiometric determination of Pu, preparation of U–Pu–Mo solutions, and spectrophotometric determination of Mo in U–Pu–Mo and U–Mo solutions. NSA

N67-35219# Los Alamos Scientific Lab., N. Mex.
INSTABILITY AND PHASE TRANSITION IN AN ANHARMONIC CHAIN
John S. Shier Feb. 1967 7 p refs
(Contract W-7405-ENG-36)
(LA-3670) CFSTI: HC $3.00/MF $0.65

A simple anharmonic chain model is presented, and it is demonstrated how the anharmonic forces give rise to a low temperature instability and a phase transformation. Approximate expressions are given for the transition temperature and the interaction strength necessary to produce a phase transformation. Author (NSA)

N67-35222* Houston Research Inst., Inc., Tex.
EXAMINATION OF THE CHEMISTRY INVOLVED IN ANODIC OXIDATION OF SILVER IN THE SYSTEM—SILVER:OXYGEN:INHIBITED GLYCOL/WATER SOLUTION Final Report
H. S. Nagaraja Setty 28 Jul. 1967 33 p refs
(Contract NAS9-6698)
(NASA-CR-65681) CSCL 07C

Over 50 papers, reports, and books were obtained and studied in order to get an insight into the chemistry involved during electrolysis of RS89a solution using silver covered copper wire. Electrolyses were conducted under several different conditions and types of electrodes and electrolytes using 27 volts d.c. potential. The anode deposit obtained in each case was analyzed for elemental composition. From the results, it was concluded that the major product of electrolysis was oxides of metal (silver/or copper). The metal amines were also formed and their amount was limited by the availability of triethanolamine phosphate in the electrolyte. The generation of sparks and smoke during electrolysis were recorded photographically. Author

N67-35244 Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Institut fuer Chemie.
ANALYSIS OF TRACE ELEMENTS IN PETROLEUM OF THE MATZEN–AUERSTHAL FIELDS WITH NEUTRON ACTIVATION ANALYSIS. FIRST REPORT: ANALYSIS OF LONG-LIVING NUCLIDES [BESTIMMUNG VON SPURENELEMENTEN IN ERDOELEN DES FELDES MATYEN–AUERSTHAL MIT NERTRONENAKTIVIERUNGSANALYSE. 1. MITTEILUNG (BESTIMMUNG VON LANGLEBIGEN NUKLIDEN)]
B. Patek, H. Bildstein, and E. Demmel 1967 10 p refs In GERMAN; ENGLISH summary
(SGAE-CH-46/1967)

A combination of liquid–liquid extraction, precipitation, and ion exchange allowed a separation of the elements iron, zinc, antimony, silver, chromium, cobalt, selenium, and scandium in artificial mixtures representing trace impurities of crude oils. The chemical yield reached 85% to 95%. Author

N67-35254# General Electric Co., Philadelphia, Pa. Missile and Space Div.
ANALYTICAL FOUNDATIONS OF AEROTHERMOCHEMISTRY
Fausto G. Gravalos 12 Sep. 1966 36 p refs
(Doc.-66SD259) CFSTI: HC$3.00/MF$0.65

Three hypotheses are presented to provide a complete and general formulation of the flow of a reacting gas mixture: (1) The heat conduction and diffusion are zero. (2) All the components of the mixture obey the laws of ideal gases. (3) The flow is axially symmetric. These conditions embody the essentials of the aerothermochemistry of inviscid gases. The chemical model used represents the atmosphere below 200,000 feet, for Mach numbers equal to or smaller than 30. The stoichiometric equations describing the chemical mixture are derived. The nature and properties of the system of differential equations are established for any type of gas mixture. It is shown how solutions of more complex boundary value problems, such as flows about sharp or blunted cones, can be obtained using the basic methods described. Author

N67-35261# Istituto di Ricerche (G. Donegani), Novara (Italy).
STUDY OF A METHOD OF PREPARING COMPOUNDS LABELLED WITH P-32 OF HIGH SPECIFIC ACTIVITY, STARTING FROM "CARRIER-FREE P-32" [STUDIO DI UN METODO DI PREPARAZIONE DI COMPOSTI MARCATI CON ^{32}P AD ALTA ATTIVITA SPECIFICA, OTTENUTI A PARTIRE DA ^{32}P "CARRIER FREE" Final Report
M. Dubini and G. C. Perucca Brussels, Euratom, May 1967 26 p refs In ITALIAN; ENGLISH summary
(Contract EURATOM-073-64-9 RISI)
(EUR-3453.i) CFSTI: HC$3.00/MF$0.65

The possibility was examined of utilizing the P-32 contained in the residue from distillation of irradiated sulphur as a starting substance in the preparation of organic and inorganic compounds labelled with P-32 of high specific activity. Two types of reaction were tested: (a) Introduction reaction: phosphorus was reacted with sulphur and halogens in the presence of the distillation residue. High introduction rates were obtained. (b) Exchange reaction: exchanges were performed between the distillation residue and numerous phosphorus derivatives. The labelling rates remained low. With the introduction reaction it is very important to irradiate the sulphur in the absence of oxygen, otherwise the reactivity of the P-32 is considerably lowered. The introduction reactions and paper chromatography showed that in the irradiated sulphur samples the P-32 is present, to a large extent, in a chemical form that is particularly reactive with oxygen. Starting with $^{32}P_2S_5$ and $^{32}PCl_3$, a number of samples were synthesized of o,o-dimethyldithiophosphate-β-phenylacetate of ethyl P-32 (Cidial) and of o,o-diethylthiophosphate-3-4 tetramethyleneumbelliferone P-32 (Dithione), with a specific activity of 10–27 mc/mM. Author

N67-35265 Technische Hochschule Munchen (West Germany). Fakultaet fuer Allgemeine Wissenschaften.
CONTRIBUTION TO THE COORDINATION OF VIBRATION BANDS OF CYANIDE BASED DYES [BEITRAEGE ZUR ZUORDNUNG VON SCHWINGUNGSBANDEN CYANINARTIG GEBAUTER FARBSTOFFE]
Hans-Holger Bock (Ph.D. Thesis) 1966 23 p refs In GERMAN

Homolog series of simple, open-chain polymethine dyes were studied for classification of the oscillation bands. The dyes were mainly studied by infrared, Raman, and fluorescence spectroscopy. An evaluation of all emission spectra of the cyanines that were studied indicates that the ground state of the oscillation quantum does not differ from the excited state within error limitations. Transl. by K.W.

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N67-34046# Arizona Univ., Tucson. Engineering Experiment Station.
STUDY OF PLASMA SHEATH EFFECTS ON ANTENNAS Final Report, 1 Jan. 1964–31 Mar. 1967
George Tyras Apr. 1967 19 p refs
(Contract AF 19(628)-3834)
(AFCRL-67-0300; AD-653995) CFSTI: HC$3.00/MF$0.65

The Final Report under Contract AF19(628)-3834, summarizes the work carried out during the period 1 January 1964-31 March 1967 in the Engineering Experiment Station, The University of Arizona. The work covers experimental and theoretical investigations into the problem of plasma sheath effects on antennas. In the area of experimental investigations, the effects of plasma sheath homogeneities and nonuniformities on the radiation pattern and input impedance were assessed. In the area of theoretical investigations, the effects of the structure curvature and the radiation patterns were assessed. The effect of plasma compressibility was also investigated. Author (TAB)

N67-34057# General Dynamics/Electronics, Rochester, N. Y.
FORESHORTENED CENTER-FED VHF ANTENNA Semiannual Technical Report
30 Jan. 1967 30 p refs
(Contract DA-28-043-AMC-02477(E))
(AD-653843) CFSTI: HC$3.00/MF$0.65

The report covers a foreshortened center-fed VHF antenna. This type of structure provides optimum decoupling from a vehicle frame, resulting in minimal pattern and impedance effects. The antenna is capable of operation in a range from 30 to 76 mc and is fully compatible with matching unit-base MX-6707( )/VRC. It has reduced length (six foot maximum), direct replacement for the whip assembly of the AS-1729( )/VRC antenna. When installed in military vehicles on antenna base assembly MX-6707( )/VRC and used with receiver–transmitter radios RT-246( )/VRC and RT-524( )/VRC, it is automatically tuned to one of ten subbands of the radio set. Also, it is capable of operating with the AN/PRC-70 and AN/PRC-25 radio sets. Author (TAB)

N67-34068# Naval Ordnance Lab., Corona, Calif.
HORIZONTAL VLF TRANSMITTING ANTENNAS NEAR THE EARTH
Elwin W. Seeley and Philip H. Wiborg 15 May 1967 57 p refs
(NOLC-721; AD-653851) CFSTI: HC$3.00/MF$0.65

Problems encountered in VLF radiation are outlined and variations of the horizontal dipole are proposed as a solution. Equations are derived for the radiation patterns, input impedance, and efficiency of the broad-band antenna (terminated in its characteristic impedance) and of the narrow-band antenna (open-terminated) where the antenna is fed at any position along its length. Data are presented to substantiate that (1) the horizontal dipole near the earth exhibits super gain when several parallel conductors are used; (2) the radiation efficiency of n closely spaced conductors is n times greater than when the same conductors are spaced one-half wavelength apart; and (3) the lossy horizontal dipole normally does not resonate when its length is a multiple of one-half wavelength. The lossy lengthening factor is shown in a plot of the resonant length as a function of Q. This plot applies generally to all lossy dipoles. Author (TAB)

N67-34083# Airtron Inc., Morris Plains, N. J.
DUPLEXER FOR SIDE-LOOKING RADAR Quarterly Report, 1 Apr. 1965–30 Dec. 1966
M. King and B. Maher Apr. 1967 21 p
(Contract DA-28-043-AMC-00280(E))
(R11-524; QR-4; ECOM-00280; AD-653782) CFSTI: HC $3.00/MF $0.65

The following information is contained in the report: results of the investigation of cobalt doped magnesium, manganese ferrite materials in the three port circulator; results of the investigation of dysprosium doped yttrium, iron garnet materials in the three port circulator; results of the deliverable model microwave limiter; and the results of the investigation of cobalt doped magnesium, manganese ferrite and hybrid garnet materials in the four port switch. TAB

N67-34134# Army Electronics Labs., Fort Monmouth, N. J.
DESIGN OF INTEGRATED ELECTRONIC D/A CONVERTER FOR DRIVING CRT DISPLAY OF ELECTRONIC SCANNER RADAR
George A. Hrivnak and Edmund Malecki Mar. 1967 17 p
(ECOM-2822; AD-654131) CFSTI: HC $3.00/MF $0.65

The use of a phased array to perform electronic beam steering in a radar set can result in significant power reduction and improved camouflage capability through the use of digitally controlled, reciprocal latching phase shifters. This report deals with the design of an integrated D/A converter which will provide deflection voltage to the CRT display of the electronic scanner radar set as a function of the digital steering information. Author (TAB)

N67-34215# TUAB Teleutredningar A.B., Solna (Sweden). Space Technology Group.
NUMERICAL METHOD FOR ROCKET TRAJECTORY DETERMINATION FROM MULTISTATION DOPPLER TRACKING DATA
Johan Martin-Loef Apr. 1967 30 p refs Sponsored by NASA and Swed. Space Res. Comm.
(Rept.-67-K3) CFSTI: HC $3.00/MF $0.65

A numerical method for calculation of rocket coordinates from roll-corrected doppler data is described. Troposheric refraction correction is included as well as a routine for obtaining a starting point. A new method to optimize the choice of starting point is also described. The computer program has been successfully used to reduce data from firings in Sweden 1964. Error estimates are given. Author (ESRO)

N67-34221 Kiruna Geophysical Observatory (Sweden).
PERIODIC FADING OF VLF SIGNALS RECEIVED OVER A POLAR PATH DURING SUNSET AND SUNRISE
S. Westerlund Mar. 1967 13 p refs
(KGO-672)

VLF radio signals from the transmitter NPM/26.1 kHz have been recorded in Kiruna, Sweden. The signals show very strong mode interference with frequent cycle slippage. From the data it is concluded that by night the first and second order modes have almost exactly the same attenuation and a phase velocity difference of 0.51%, which is in agreement with Wait and Spies' calculations for a nighttime ionosphere of height 90 km and a lower waveguide boundary of infinite conductivity (sea water). When the same model is used for the excitation factors the mode conversion factor is determined and is found to depend strongly on the angle between the shadow line and the great circle path. Author

N67-34256# Joint Publications Research Service, Washington, D. C.
THE TECHNICAL PERFORMANCE OF NON-PULSE RADAR SYSTEM (PART I AND PART II)
Wang-p'ing T'ao *In its* Transl. on Communist China's Sci. and Technol., No. 379 25 May 1967 p 1–25 refs Transl. into ENGLISH from Wu-hsien-tien Chi-shu (Peking), no. 5, 11 May 1966 p 2–6; no. 6, 11 Jun. 1966 p 21–25 (See N67-34255 20-34)

The general characteristics of the FM, negative, and Doppler guidance radar systems are reviewed. Recent advances in the elimination of stationary errors regarding single target FM radar are discussed. The properties of pulse radar and FM radar are compared, and it is felt there is insufficient data to determine the better system for single target detection. Multi-target FM radar is also covered. The basic work theory and structure of the negative radar receiving system are outlined. The major difficulty encountered with the negative radar equipment is considered to be its relative complexity. The work theory and components are also described for the active guidance system and various receiving systems of the Doppler guidance radar. Doppler radar antenna types and the antenna stability device are mentioned. N.E.N.

N67-34337# Collins Radio Co., Cedar Rapids, Iowa.
TV-37 VHF AND TU-11 UHF 2000-WATT TRANSMITTERS Final Report, Feb. 1965–Feb. 1966
C. H. Kirkpatrick, C. J. Schubert, and R. W. Grosser Jun. 1967 133 p
(Contract FA-65-WA-1068)
(RD-67-16)

The design, fabrication, and testing of TV-37 and TU-11 Transmitters are discussed in this report. The TV-37 develops 2000 watts of carrier power, is amplitude modulated, and is in the 118- to 136-megahertz band. The TU-11 develops 1500 watts of carrier power, is also amplitude modulated, and is in the 278- to 328-megahertz band. Both transmitter types use essentially the same unit with only minor changes necessary to convert from one to the other. The FAA 50-watt transmitter, type TV-36 or TU-9, is used to drive one linear class AB_1 stage in the TV-37 or TU-11 respectively. Safety features protect service personnel. Silicon solid-state components, where possible, along with conservative design ensure reliable operation. Interlocks and monitoring circuits reduce the chance of transmitter damage due to component failure or operator error. One set of equipment was developed to provide angle modulation for the TV-36. Considerable design and development was necessary to ensure proper cooling and electrical stability of the final amplifier stage. Extensive and inclusive testing has shown that the final design meets or exceeds all major development objectives. Author

N67-34352# RAND Corp., Santa Monica, Calif.
THE PERFORMANCE OF SEVERAL INCOHERENT SEQUENTIAL DETECTORS
L. H. Wegner Apr. 1967 73 p refs
(Contract F44620-67-C-0045)
(RM-5318-PR; AD-653514) CFSTI: HC $3.00/MF $0.65

An evaluation of the performance of several sequential detectors for the case of incoherent detection; that is, when the pulse-to-pulse radar returns are independent observations on the envelope of a sine wave in narrow-band Gaussian noise. Two sequential probability ratio tests (SPRTs) and the biased square law sequential detector (BSLSD) were compared for blip/scan ratio and average test time for static and fluctuating targets at known range. The SPRT for Swerlings Model II fluctuating target is the preferred sequential test; it gives a 4 to 7 db improvement over the optimum fixed-duration tests. Walds approximations for SPRT evaluation were compared with the exact results and found to be inadequate for large signal/noise ratios. The APRST and MPRST (averaged and maximum probability ratio sequential tests) were evaluated and compared with optimum fixed-duration tests for unknown range conditions (multiple range resolution cells). Author (TAB)

N67-34407*# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
ADMITTANCE OF THE INFINITE CYLINDRICAL ANTENNA IN A LOSSY PLASMA, II. THE INCOMPRESSIBLE, MAGNETOPLASMA Scientific Report
Edmund K. Miller May 1967 56 p refs
(Contract NASr-54(05))
(NASA-CR-87498; Rept.-05621-11-5) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Some numerical results are presented for the admittance of an infinite cylindrical antenna excited at a circumferential gap of finite thickness and immersed in a lossy, incompressible magnetoplasma, with the antenna axis parallel to the static magnetic field. The calculations are performed using a free-space layer of variable thickness (the vacuum sheath) to approximate the positive ion sheath which forms about a body at floating potential in a warm plasma. The antenna admittance is obtained by a direct numerical integration of the Fourier integral for the antenna current, and is presented for plasma parameter values typical of the E-region of the ionosphere. The results obtained show that in the frequency range encompassing the electron plasma (f_p), electron cyclotron (f_h) and upper hybrid frequencies, the vacuum sheath considerably reduces variations in the admittance magnitude compared with the sheathless case. A comparison of these calculated results with some measurements of antenna impedance in the ionosphere, shows there to be a qualitative agreement between theory and experiment. Author

N67-34422# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
CO-LOCATION OF COMMUNICATION EQUIPMENT AT VOR/VORTAC FACILITIES Final Report
Virgil E. Willey Mar. 1967 19 p
(RD-66-88)

This report describes the effect on the performance of a VOR/VORTAC facility when VHF and UHF communication antennas are mounted on a supporting structure near the edge of the VOR counterpoise. A slight increase in the amount of course roughness was noticed. Details on installation criteria are included. Author

N67-34439# Sandia Corp., Albuquerque, N. Mex.
RF INTERMODULATION CHARACTERISTICS OF VHF TELEMETRY PREAMPLIFIERS AND RECEIVERS
H. O. Jeske May 1967 23 p refs
(Contract AT(29-1)-789)
(SC-DR-67-298) CFSTI: HC $3.00/MF $0.65

Tests were conducted on ten preamps and six receivers to quantitatively determine their linear operating range. The range of linear operation was determined by the measurement of, or the effects of, intermodulation products that were produced by the simultaneous application of two input signals. Measurements were made at a frequency equal to twice the frequency of one signal source minus the frequency of the other signal source. Preamp test results indicated that their dynamic range varies from approximately 46 to 70 db. It was found, under the best conditions with some receivers, that their proper operation was prevented by the presence of two signals that were less than 30 db larger than the desired signal. The two interfering signals were located well outside the rated −60 db bandwidth of the receiver. Author (NSA)

N67-34514# Commerce Dept., Washington, D. C. Telecommunication Science Panel.
ELECTROMAGNETIC SPECTRUM UTILIZATION—THE SILENT CRISIS
18 Oct. 1966 90 p refs
GPO: $0.50

Status and trends in the technology and use of the electromagnetic spectrum were assessed to determine ways of increasing the effectiveness of its use. Consideration was given to research and technical services concerned with electromagnetic wave propagation, transmission media, antennas, information transmission and noise, as well as operational and economic factors, and engineering data. Based on panel findings, a recommendation is proposed that a federal research organization be developed to provide electromagnetic spectrum economic, social, and technical information and analyses, and identify and stimulate those technical research programs which are essential to the improvement of overall effectiveness of spectrum utilization. Summaries of related national and international studies, and recommendations on this subject are included. E.C.

N67-34531# California Univ., Los Angeles. Western Management Science Inst.
ECONOMIC THEORY OF INFORMATION
Jacon Marschak May 1967 122 p refs /its Working Paper No. 118
(AD-654163) CFSTI: HC $3.00/MF $0.65

Problems of statistical decision and of communication economics are shown to be special cases of the general problem of joint efficient choice of the observable, the code, the channel, and the strategy, given the payoff function and the available resources. Author (TAB)

N67-34543*# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
DETECTION OF CHANGES IN THE CHARACTERISTICS OF A GAUSS-MARKOV PROCESS
P. M. Newbold and Y. C. Ho Jun. 1967 43 p refs
(Grant NGR-22-007-068; Contract Nonr-1866(16))
(NASA-CR-87477; TR-531) CFSTI: HC $3.00/MF $0.65 CSCL 09D

By an extension to the theory of sequential detection with dependent measurements, it is possible to develop a Sequential Probability Ratio Test (SPRT) to detect changes in regime in a Gauss-Markov process rather than detecting which of two regimes exist. It is shown how a posterior form of this extended SPRT may be simplified to reduce computational complexity. The simplified SPRTs are in fact modifications of the original SPRT detecting the regime and not the change. The tests are applied to the problem of fault detection in a gyro navigational system; the results of a detailed computer simulation are given. Author

N67-34552 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS OF INFORMATION TRANSMISSION Selected Articles
31 Jan. 1967 98 p refs Transl. into ENGLISH from Probl. Peredachi Inform. (Moscow), v. 1, no. 1, 1965 p 12-25, 41-51, 57-64, 65-71, 72-79, 113-116, 117-121
(FTD-HT-66-297; TT-67-62127; AD-653548)

CONTENTS:

1. BINARY CODES WITH CORRECTION OF OMISSIONS AND INSERTS OF THE SYMBOL 1 V. I. Levenshteyn p 1-22 refs (See N67-34553 20-07)
2. REALIZATION OF A BOOLEAN FUNCTION OF n INPUTS Ye. A. Butakov p 23-41 refs (See N67-34554 20-10)
3. SOME PROPERTIES OF SYMMETRIC FUNCTIONS OF TRIADIC LOGIC B. L. Osiyevich p 42-55 refs (See N67-34555 20-10)
4. THE BEHAVIOR OF AUTOMATA IN PERIODIC RANDOM MEDIA AND THE PROBLEM OF SYNCHRONIZATION IN THE PRESENCE OF INTERFERENCE V. I. Varshavskiy, M. V. Meiashina, and M. L. Tsetlin p 56-69 refs (See N67-34556 20-10)

5. ON THE USE OF ORDERED TEXTS FOR EXTENDING THE POSSIBILITIES OF READING DEVICES V. S. Fayn p 70–83 (See N67-34557 20-03)

6. ON THE COMPLEXITY OF DECODING M. S. Pinsker p 84–91 refs (See N67-34558 20-07)

7. CYCLIC CODES CORRECTING UNIFORM ERROR PACKETS Yu. L. Sagalovich p 92–98 ref (See N67-34559 20-07)

N67-34553 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BINARY CODES WITH CORRECTION OF OMISSIONS AND INSERTS OF THE SYMBOL 1

V. I. Levenshteyn *In its* Probl. of Inform. Transmission 31 Jan. 1967 p 1–22 refs (See N67-34552 20-07)

In this paper binary codes of length n with correction of omissions and inserts of the symbol 1 according to the scheme used previously to study binary codes with correction of omissions and inserts of arbitrary symbols (0 or 1) are investigated. A method of setting up an asymptotically optimum code (for $n \to \infty$) with correction of the omission or insert of one symbol 1 as well as a method of setting up codes with an asymptotic minimum of excess elements and allowing the correction of s or less omissions and inserts of the symbol 1 are set forth. The optimum choice of the separating word permitting automatic decoding of the output of the channal in which in each segment of the length n at most s omissions and inserts of the symbol 1 take place is performed. Author

N67-34558 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE COMPLEXITY OF DECODING

M. S. Pinsker *In its* Probl. of Inform. Transmission 31 Jan. 1967 p 84–91 refs (See N67-34552 20-07)

This paper shows that for a very general class of channels in the case of arbitrary speed of transmission lower than the carrying capacity of the channel, methods of coding can be constructed such that the number of operations in decoding is smaller than some constant independent of the error probability. This paper is a preliminary publication. It shows that for a very general class of channels, for any speeds of transmission R lower than the carrying capacity of the channel C, methods of group coding and decoding can be constructed such that the number of operations in decoding corresponding to one information symbol will be smaller than some constant independent of the error probability of decoding ϵ (but depending on R, and with a delay time ν depending on ϵ). Author

N67-34559 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CYCLIC CODES CORRECTING UNIFORM ERROR PACKETS

Yu. L. Sagalovich *In its* Probl. of Inform. Transmission 31 Jan. 1967 p 92–98 ref (See N67-34552 20-07)

The concept of an error packet that is uniform with respect to a number is introduced. It is shown the number of control symbols to correct such packets is considerably decreased in comparison with the general case. Author

N67-34607 Royal Aircraft Establishment, Farnborough (England).

TRANSMISSION METHODS FOR SATELLITE LINKS [UBERTRAGUNGSVERFAHREN BEI SATELLITENVERBINDUNGEN]

W. Arens May 1967 14 p Transl. into ENGLISH from Nachr. Tech. Z. (Brunewick), no. 1, 1967 p 7–11 (RAE-LIB-TRANS-1236)

The transmission quality required on satellite links is specified. The overall transmission loss varies from case to case (telecommunications, television service, space probes) but is always at least 50 dB greater than in terrestrial radio links. In order to avoid excessive transmitter power levels in the satellites it is usual to utilize a noise reduction by increasing the bandwidth up to the limit imposed by the noise threshold of the particular method. In point-to-point links frequency modulation has slight advantages over pulse code modulation and is considerably better than any single-sideband modulation. In the case of multiple access by many ground stations however, single-sideband modulations on the ground-to-satellite path is a promising alternative to frequency modulation. Author

N67-34638# European Atomic Energy Community, Ispra (Italy). Engineering Dept.

STUDY ON A GENERAL TECHNICAL SOLUTION FOR A DATA-TRANSMISSION PROBLEM IN A NUCLEAR RESEARCH CENTER [STUDIE EINER GENERALLEN TECHNISCHEN LOESUNG DES DATENUEBERTRAGUNGS-PROBLEMS IN EINEM KERNFORSCHUNGSYENTRUM]

W. Becker Brussels, May 1967 34 p refs In GERMAN; ENGLISH summary (EUR-3470.d) CFSTI: HC $3.00/MF $0.65

An on-line data transmission system between research center laboratories and the calculation center, as well as data links between different laboratories, is discussed. A single, ramified coaxial cable network is proposed. Related circuitry and necessary calculations are treated in detail. The main advantages of this system are considered to be its flexibility in adapting to changing gravity points of data sources and data processing. Ease of access, potential to increase subscribers, and the capability to change the applied signal types are other advantages. E.C.

N67-34691# Japan Broadcasting Corp., Tokyo.

SIMULTANEOUS TRANSMISSION OF TWO SOUND CHANNELS IN TELEVISION

Saburo Yamane and Yukoh Fujii Mar. 1967 16 p refs *Its* Ser. No. 109 CFSTI: HC $3.00/MF $0.65

The simultaneous transmission of two sound programs for television broadcasting can be employed in various services, such as the broadcasting service in a country having two languages, simultaneous broadcasting service of foreign films in the original and translated languages, and international program exchange service. In order to embody the above mentioned transmission system, a series of experiments on various methods, were conducted. It revealed that the frequency-divided transmission system is most practicable, and FM–FM and SSB–FM systems are most suitable for this frequency-divided transmission system. Author

N67-34707# Japan Broadcasting Corp., Tokyo. Acoustics and Audio Frequency Research Div.

RECENT STUDIES IN ARTIFICIAL REVERBERATION AT NHK TECHNICAL RESEARCH LABORATORIES

Hikaru Date, Zyn-ichi Uzihara and Yoshinori Tozuka Mar. 1967 10 p refs *Its* Ser. No. 110

Specifications for an analog artificial reverberator that can control maximum value of reverberation time, reverberation time-frequency characteristics, transmission characteristics, and the size of the simulated room independently and freely. The reverberator has potential application for studying the physical quantity relations and subjectively experienced tonal quality of rooms used for radio and television broadcasting programs. Curves of some available types of reverberation time-frequency characteristics and calculations for transfer functions of the system are presented. Some factors concerning the physical realization of all-pass function circuits are commented upon. L.S.

N67-34778*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS SYSTEMS RESEARCH
In its Space Programs Sum. No. 37-45, Vol. IV 30 Jun. 1967 p 259-311 refs (See N67-34761 20-30)

Block coding and synchronization are considered, and a maximum-likelihood method of phase estimation is proposed for optimum tracking of phase shift keyed modulated carriers. The problem of signal design is examined for channels characterized by the presence of an additive noise component dependant multiplicatively on the signal in such a way that increasing the signal energy increases the noise power. In relation to combinatorial communication, a multiplier theorem for difference sets is presented. To determine the effect of atmospheric variations on high precision tracking, ground and balloon weather data were used. Results indicate that for higher accuracies, atmospheric parameters for range, Doppler, and elevation angle corrections will have to be obtained on a real-time basis. Mathematical models are developed to determine error rates in phase coherent systems with bandpass limiters, and radio losses in block-coded communication systems are evaluated. Derivatives of a band-limited function are computed. For data compression of space telemetry, a goodness-of-fit test is extended to six and eight quantiles. M.G.J.

N67-34779*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS ELEMENTS RESEARCH
In its Space Programs Sum. No. 37-45, Vol. IV 30 Jun. 1967 p 313-337 refs (See N67-34761 20-30)

Improved instrumentation and data reduction techniques are discussed for obtaining better measurement resolution during a lunation experiment. A study leading toward a laboratory demonstation of a 10.6 μm carbon dioxide laser heterodyne receiver is described, and the problems involved in developing an efficient isotopic carbon dioxide laser are reviewed. In conjunction with planetary entry blackout, a plasma environment model was used to estimate the frequency shift as well as the attenuation of the signal passing through the plasma column. Low noise transponder preamplifier research is reported, and typical parameter values are compared for three solid state preamplifiers. A preliminary evaluation is presented on a plastic waveguide technique of fabricating thermally isolated transmission lines for spacecraft onboard communication systems. High pressure RF breakdown data in air are given for a rigid coaxial transmission line obtained at S-band frequencies. A three-dimensional surface representing both multipacting and higher pressure RF breakdown data is also discussed. Design considerations and test data are included on high impact cavity-backed spiral antennas, and large aperture antennas. M.G.J.

N67-34780*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT RADIO
In its Space Programs Sum. No. 37-45, Vol. IV 30 Jun. 1967 p 338-351 refs (See N67-34761 20-30)

The beam configuration performance of spacecraft guidance radars is analyzed, with attention focused on the variances of the range and velocity estimates. The beam geometry chosen is applicable to a Mars retrolander. To estimate performance margin and cost trade-off for spacecraft telecommunication system design, a probability design principle in relation to cost is used. The total cost of the mission rather than the cost of the communication system alone is optimized. The average mission cost as a function of power-gain product is obtained, and the point of diminishing returns is determined graphically. This relationship is demonstrated first by a Mars-distance mission and second by a long distance mission, with a nominal power-gain product of 20 dBm over that of the former. A similar analysis reflecting the loss of scientific measurement capacity, as a result of the payload weight increase for a higher margin of performance, is also given. This analysis ignores the possibility that some scientific measurement capability can be accommodated by sacrificing operation time and bit error. M.G.J.

N67-34783# Page Communications Engineers, Inc., Washington, D. C.
LONG DISTANCE VHF/UHF COMMUNICATIONS GROUND ANTENNA ARRAY Final Report
John H. McMahon Feb. 1967 156 p refs
(Contract FA-64-WA-5177)
(RD-67-11)

Reported is the development of a dual VHF/UHF antenna for ground-to-air extended range communication. The antenna contains a 32 dipole VHF array (127-136 mHz) and a 32 dipole UHF array (277-329 mHz) in a 60° screen corner reflector. The antenna including reflector is supported by a triangular guyed steel tower with a nominal 15-foot cross section. The supporting tower is 225 feet high. Each array is fed by a 50-ohm transmission line harness forming a binary corporate structure. The harness used standard 7/8" and 1-5/8" flexible air dielectric 50 ohm cables and contractor developed binary power dividers. The complete transmission line harness, binary transformers, and dipole feed points are pressurized with dry air from a dehydrator. Described are: prototype development; the test program at Maui, Hawaii; power handling capability; methods used in measuring isolation between VHF and UHF antenna arrays; antenna input admittances; antenna pattern and gain measurements; antenna received powers; the mechanical design; beam tilt, and minimum electrical specifications. S.C.W.

N67-34795# Societe pour l'Etude et la Realisation d'Engins Balistiques, Courbevoie (France).
ANALYTICAL STUDY OF EQUIPMENTS [ETUDE ANALYTIQUE DES EQUIPMENTS]
Dec. 1964 66 p In FRENCH Prepared for ELDO
(DTA-50-4644, Append. II) CFSTI: HC $3.00/MF $0.65

A detailed functional analysis of the following ELDO A-S equipment is presented: telecommunication, command control, telemetry, infrared detection and guidance, satellite power supply (solar cells). ESRO

N67-34833# Naval Research Lab., Washington, D. C.
NRL TERRAIN CLUTTER STUDY, PHASE I Final Report
Norman W. Guinard, John T. Ransone, Jr., Michael B. Laing, and Lenard E. Hearton 10 May 1967 85 p refs
(NRL-6487; AD-653447) CFSTI: HC $3.00/MF $0.65

The first phase of a terrain-clutter study has been completed at NRL, utilizing the four-frequency radar system installed in a WV2-128324 (Super Constellation) aircraft. This system is capable of transmitting and receiving four frequencies (P, L, C, and X) consecutively with a choice of horizontal, vertical, and alternating polarizations. The returns are gated at a fixed range and analyzed in a digital computer. Absolute clutter measurements have taken over both Canadian and American sites at angles of incidence of 10 degrees or less. Two parameters have been measured. The first is the normalized radar cross section in terms of the 10, 50 (median), and 90 percentile values of its distribution, while the second is the fluctuation power spectrum of the coherent radar return signal. Two types of statistical processes have been determined from the cross-section data; one follows a Rayleigh distribution between 10 and 90 percentile values, and one departs radically from this distribution. The energy in the fluctuation power spectrum has been estimated in frequency bands whose spacing is determined by the transmitted frequency, e. g., 2 cps at P band through 10 cps at X band. The root mean square deviations of the estimates indicate likewise a Rayleigh behavior for certain bands and a radical departure from this behavior. In this case, the radical departure is identified as a Ricean (signal plus noise) distribution produced

by strongly reflecting point targets in the illuminated area. A statistical model for terrain clutter is proposed which will enable the phenomenon disclosed by the study to be simulated based upon the optical analysis of Synthetic Aperture Radar Maps. Author (TAB)

N67-34879# European Space Vehicle Launcher Development Organization, Paris (France). Future Programs Directorate.
TRACKING REQUIREMENTS FOR A 24 HR. SATELLITE STATION KEEPING CONTROL SYSTEM
R. Cosaert Nov. 1966 26 p refs
(ELDO-TM-F-38) CFSTI: HC $3.00/MF $0.65

It is shown that for a tracking station that measures only two evaluation angles (α, β) and that sees a synchronous satellite at zenith the associated tracking requirements are $\epsilon_p = \epsilon_F + 0.2°$ in order to limit the diurnal variation to 0.3° in longitude, 0.2 in latitude and to maintain a limit cycle of 0.5° of the steady libration motion of the centre of the diurnal ellipse. The method used to derive these specifications can easily be extended to include nonequatorial tracking sites with arbitrary angles of elevation associated with the 24 h satellite to be tracked. Author (ESRO)

N67-34898*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
CHARACTERISTICS OF A SPLIT PHASE TELECOMMUNICATIONS LINK
William E. Zrubek Washington, NASA, Sep. 1967 19 p refs
(NASA-TN-D-4163) CFSTI: HC $3.00/MF $0.65 CSCL 17B

A split phase telecommunications link is described and its performance analyzed. A spectral analysis of the transmitted signal is performed. An analysis is made of the operation of a carrier tracking phase-lock loop receiver when its input is a split phase signal. The effects of increased loop bandwidth and of a noisy phase reference are presented. The data signal output of the loop as a function of time is obtained. Author

N67-34945# European Space Technology Center, Delft (Netherlands).
INFLUENCE OF BANDWIDTH RESTRICTION ON THE SIGNAL-TO-NOISE PERFORMANCE OF A PCM/NRZ SIGNAL
H. Martinides and G. L. Reijns Paris, ESRO, Dec. 1966 34 p refs
(ESRO-TM-16) CFSTI: HC $3.00/MF $0.65

This report contains original work about the influence of bandwidth restriction on the performance of a transmission system using pulse code modulation. In particular, the relationship is investigated between signal/noise, bandwidth and bit-error probability of an NRZ (non return to zero) signal. The detector used in the investigation contains a device which integrates the signal over the bit period. Theoretical results were obtained by a Fourier analysis of the bandwidth-restricted signals and by an auto-correlation analysis for the bandwidth-restricted noise. Theoretical and experimental results are in good agreement. Author

N67-34981*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE FEASIBILITY OF A DIRECT RELAY OF APOLLO SPACECRAFT DATA VIA A COMMUNICATION SATELLITE
P. E. Schmid Washington, NASA, Aug. 1967 52 p refs
(NASA-TN-D-4048) CFSTI: HC $3.00/MF $0.65 CSCL 17B

An estimate of the extent to which communication satellites can be utilized in the 1970's for relaying data directly from an Apollo-type spacecraft to a fixed earth station is provided. Both 24-hour synchronous altitude (36,000 km above the earth's surface) and 6-hour orbits (10,400 km above the earth's surface) for the communication satellite are considered. A Unified S-Band type of data transfer is assumed. The relative merit of using frequencies below S-Band for voice communication is also briefly discussed. Author

N67-34998*# Advanced Technology Corp., Timonium, Md.
STUDY PROGRAM ON (30–100 GHz) ELECTRONICALLY STEERABLE ANTENNA SYSTEMS Quarterly Report, 20 Sep. 1966–20 Jan. 1967
20 Jan. 1967 76 p refs
(Contract NAS5-10256)
(NASA-CR-88509; QR-2) CFSTI: HC $3.00/MF $0.65 CSCL 17B

Six steerable antenna systems recommended as having potential application to millimeter wave satellite applications are considered. The work results in a recommendation of one type of radiating aperture—a filled aperture comprised of a reasonably small number of moderate gain elements. Basically, two different distribution systems are recommended for illumination of the aperture—a closed waveguide series feed and a quasi-optical horn feed. The steering capability will be achieved through the use of a properly programmed phase shifter at each radiating element. Within this framework a possible modification introducing a harmonic generator at each element is also discussed. This will be a useful technique whenever the primary lower frequency power exceeds the input capabilities of a single last stage multiplier. Author

N67-35015*# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
STEEPEST DESCENT AND THE MERGING OF SEVERAL WAVES
Craig Comstock 15 Aug. 1967 25 p refs
(Grant NsG-134-61)
(NASA-CR-87652; SR-303) CFSTI: HC $3.00/MF $0.65 CSCL 20N

The question of how to obtain an analytic description of the merging of several waves is studied. It is assumed that the wave structure is given as a complex integral (say a Fourier integral) and an asymptotic approximation is desired. Motivated by the work of Ursell we study the asymptotic properties of integrals of the form $\int \exp ip\,(t)\,dt$ where $\rho(t)$ is a polynomial in t. Explicit asymptotic formulas are obtained for the two types of polynomials $p(t) = zt + t^{n+1}/n+1$ and $p(t) = a_1 t + a_2 t^2 + \ldots + a_{n-1}t^{n-1} + t^{n+1}/(n+1)$. Author

N67-35023# Telespazio, S. P. A., Rome (Italy).
THE ITALIAN EARTH STATION FOR SATELLITE COMMUNICATIONS AT FUCINO
P. Fanti *In* European Space Vehicle Launcher Develop. Organ. ELDO Tech. Rev., vol. 2, no. 1 1967 22 p (See N67-35021 20-31)

An outline of the history, a technical description and an account of the experiments and operations carried out at the earth station for satellite communications at Fucino are given. Author (ESRO)

N67-35061# Institut Franco-Allemand de Recherches, St. Louis (France).
DEVELOPMENT OF TELEMEASURE TRANSMITTERS FOR DATA TRANSMISSION FROM FLYING BODIES, PART II [ENTWICKLUNG VON MESSWERTSENDERN ZUR DATENUEBERTRAGUNG AUS FLUGKOERPERN, TEIL II]
G. Schultze 1 Dec. 1965 40 p refs In GERMAN Supported by Ger. Defense Min.
(ISL-T-41/65)

Improved circuitry and the incorporation of a two channel multiplexing system in telemeasure transmitters of high velocity projectiles increased their static temperature measurement accuracy.

Various measuring systems were investigated in an effort to avoid velocity sensitive batteries (b>60,000 g) and to develop the necessary transmitter voltage by increased high frequency energy from a 100 watt generator of 27 mHz inside the projectile. A newly developed broadband receiver of 27 mHz secured the reception of signals from the telemetry source. A cheap time multiplexer telemetry system with 3 to 4 channels was developed for data transmission from extended range artillery rockets. Transl. by G.G.

N67-35172*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
THE HAYSTACK-MILLSTONE INTERFEROMETER SYSTEM
Alan E. E. Rogers 15 Mar. 1967 48 p refs
(Grant NsG-419; Contract DA-36-039-AMC-03200(E))
(NASA-CR-84615; TR-457; AD-652398) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The Haystack 120-ft antenna and the Millstone 84-ft antenna have been coupled together to form a radiometric interferometer. At 18-cm wavelength, which was chosen for a study of galactic OH emission, the interferometer has a minimum fringe spacing of 54 seconds of arc. The interferometer synthesizes a beam approximately equivalent to that of a 2000-ft parabolic antenna and can measure positions to a small fraction of the fringe spacing. The interferometer uses a digital correlator to analyze the fringe amplitude and phase as a function of frequency. This enables mapping of spectral features. The design and construction are described, as well as the theory and method of data reduction. A noise analysis shows that the threshold level could be reduced by using more complex processing techniques. It is shown that for radiometric studies many of the capabilities of a very large antenna can be synthesized, with smaller antennas and complex data-processing equipment taking the place of mechanical structure.
Author (TAB)

N67-35234*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
STUDY OF MODULATION TECHNIQUES FOR MULTIPLE ACCESS SATELLITE COMMUNICATIONS
10 May 1964 369 p refs
(Contract NAS5-3544)
(NASA-CR-87479; TR-54-154) CFSTI: HC $3.00/MF $0.65 CSCL 17B

The Design Point System Model is specified; the system performance objectives are included; and criteria for selecting a system's modulation technique is discussed. Conventional modulation techniques are classified, and time division and frequency division multiplex operations are discussed. Seven candidate combinations of conventional modulation and multiplexing are subjected to preliminary analysis. A mathematical theory of Pseudo-Noise (PN) multiplexing is developed, and the detailed logical configurations of the two techniques chosen for further study, are specified. Theory is also given for asynchronous multiplexing. Logical configurations of transmitters, receiver, and callup logic for the two PN candidates are discussed in detail. Pertinent literature concerning traveling wave tubes is summarized, and the potential influence of the tubes characteristics on multiple access communications performance is discussed. Conclusions and recommendations are given. L.S.

N67-35285 Joint Publications Research Service, Washington, D. C.
THE MINIMAX PROBLEM FOR AN ARBITRARY PAYOFF FUNCTION
I. N. Kuznetsov *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 41-52 refs (See N67-35281 20-10)

The problem of finding the optimal distribution $y_0(x)$ of the restricted resources Y for unknown a priori statistics is solved in the minimax formulation. The worst a priori distribution $p_0(x)$ is found for which even the best distribution of resources ensures the value R of the average payoff which is least by comparison with the average payoff for any other a priori distribution with optimal distribution of resources for it. The solution is found with a known payoff function satisfying very weak restrictions, and in the absence of any restrictions except the natural ones ($p(x) \geq 0$, $\int_x p(x)dx = 1$), on the a priori distribution. The proposed algorithm for solving the problem is suitable for manual and machine determination of the values of $p_0(x)$, $y_0(x)$. Author

N67-35287 Joint Publications Research Serivce, Washington, D. C.
METHODS FOR SEPARATING GROUPS OF UNRESOLVED SIGNALS FROM NOISE ON THE BASIS OF RANDOM POINT THEORY
V. G. Latysh *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 62-74 refs (See N67-35281 20-10)

On the basis of the apparatus of random point theory a posteriori characteristics of groups of unresolved signals are constructed. With the help of decision theory the operator for detection and measurement of the parameters of these groups and the number of signals in them is studied. As an example regular and fluctuating signals are investigated in white noise. Author

N67-35297 Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF ALGORITHMS FOR PROCESSING RANDOM SIGNALS BY THE MONTE-CARLO METHOD
G. N. Balasanov and B. A. Chumachenko *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 189-200 refs (See N67-35281 20-10)

An investigation is given for conversion of a random signal of the relay type arising during formation of a program for behavior of cutting tool of a mining mechanism with respect to the hypsometry of the mineral stratum. The criterion of minimization of mineral losses during the process of the indicated conversion of the incoming information is introduced. The conversion algorithm is assumed optimal in the sense of the selected criterion. Several approximate algorithms are considered and statistical results are presented. Author

N67-35298 Joint Publications Research Service, Washington, D. C.
DEFINITION OF OPTIMAL SYSTEMS WITH NONLINEAR COMBINATION OF USEFUL SIGNAL AND NOISE
L. G. Yevlanov *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 201-213 refs (See N67-35281 20-10)

For the case where the observed input signal with a fixed vector of the random parameters of the useful signal is a Gaussian random process, the a posteriori probability density of the vector of the parameters is calculated. On the basis of this probability density, it is possible to define the optimal systems with respect to different criteria of the Bayes type. Results obtained include as special cases the solutions of known problems in the definition of optimal systems with additive and multiplicative noise. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N67-34006# TRW Systems Group, Redondo Beach, Calif.
CRYOGENIC RESEARCH Final Report
Dec. 1966 98 p refs
(Contract Nonr-2542(00))
(TRW-00003-6001-R000; AD-653884) CFSTI: HC $3.00/MF $0.65

Initial work on the Persistor soon required thin film technology which was considerably beyond the state-of-the-art at that time. Consequently a major fraction of effort was then, and continued to be, devoted to the understanding of the properties of thin films and their methods of fabrication. Somewhat later it became apparent that a crossed-film cryotron could serve both as a logical element and as a memory storage element. Work on the Persistor was discontinued at that time. Another of the major technological problems both here and elsewhere was the difficulty in forming suitable dielectric films. To overcome this problem a dielectric film was developed which employed an electron beam to polymerize a slowly condensing siloxane vapor in vacuum. This proved far superior to the more conventional silicon monoxide technology. The limitations imposed by an essentially two-dimensional logic led to extensive studies of component interconnection in two dimensions. From this came the concept of an associative memory in which logic is deposited without the memory itself. This memory has the additional feature that it can be interrogated based on its contents rather than by use of an assigned address. Later work was devoted towards successful fabrication of a 900-cryotron array which was to form the basis for a small, prototype associative memory. 900-cryotron arrays were fabricated successfully with all of the cryotrons functional, but the difficulties encountered in the use and handling of large area masks ultimately prevented successful production of an associative memory array. Author (TAB)

N67-34052 Royal Aircraft Establishment, Franborough (England).
THE PUNCHED CARD OUTPUT SYSTEM FOR THE MERCURY COMPUTER
K. Sanderson, I. B. Piggott, and P. D. M. Thane Dec. 1966 32 p refs
(RAE-TR-66377)

The punched card system characteristics and operation, and the system logic design and operation are described in detail, and extensive circuit diagrams of the system and components are included. A buffer store inserted between the computer and the card punch enables data to be transferred from the computer by rows or by columns, and also allows the system to be designed as a true, on-demand, asynchronous system. N.E.N.

N67-34063# Naval Ordnance Lab., White Oak, Md.
COMPUTING, THINKING, AND DYNAMICS
William R. Thickstun 19 Dec. 1966 36 p refs
(NOLTR-67-54; AD-653446) CFSTI: HC $3.00/MF $0.65

A heuristic discussion is presented of the general problem of computing as it in fact is usually performed. The discussion has important implications for the process of constructing mathematical models. Author (TAB)

N67-34163# Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Angewandte Mathematik.
METHODS OF THE STEEPEST DESCENTS [ZUR METHODE DES STEILSTEN ABSTIEGES]
Wonnefried Kolar Dec. 1966 29 p refs In GERMAN
(JUL-445-MA) CFSTI: HC $3.00/MF $0.65

The method of the steepest descent is examined and tested using the example of zero positions of complex polynomials. Compared are two numerical approaches to the solution of a system of differential equations for fall lines. The two approaches are the Euler method and the Runge–Kutta method. A Fortran computer program was used for the calculations. Transl. by K.W.

N67-34179* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A PROGRAM FOR LISTING OF ORB3A TAPES
Henry G. Linder Jul. 1967 27 p
(NASA-TM-X-55878; X-565-67-349) CSCL 09B

The operating requirements and input for a computer program for listing of ORB3A tapes are outlined. Punched card samples of the run deck and of the output are depicted. The program provides a capability to check orbit numbers, orbit start, and stop times by listing them on a computer generated printout. The tapes were checked for correct record format and for correct parity. Error exits are provided in the tape read routine that give appropriate diagnostic messages to the user in case of read errors. L.S.

N67-34222# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
THE INPUT/OUTPUT AND CONTROL SYSTEM OF THE MOORE SCHOOL PROBLEM SOLVING FACILITY
Richard P. Morton and Michael S. Wolfberg Jun. 1967 150 p ref
(Contract Nonr-551(40))
(Rept.-67-30; AD-653465) CFSTI: HC $3.00/MF $0.65

The report documents the effort which has to date gone into providing the on-line, real-time capability needed for the Moore School problem solving facility. The facilities described allow a user at a remote terminal to prepare input, execute programs on a computer and examine his output. The programs described are responsible for controlling this process by transmitting and buffering the data to and from the computer, translating between external and internal codes, and scheduling the computers efforts. TAB

N67-34228 Joint Publications Research Service, Washington, D. C.
DEVICE FOR COMPUTING CORRELATION FUNCTIONS
V. P. Zelenen'kiy *In its* Description of Soviet Eng. Pat. 3 May 1967 p 1–2 (See N67-34227 20-14)

Devices designated for the computation of correlation functions of stationary random processes are known. The suggested device differs from the known in that the outputs of the multiplication units are connected to the inputs of the operational amplifiers which are connected through the inverting amplifier with the delay units forming a chain of positive feedback. This makes it possible to determine with comparatively simple means correlation functions of continuous non-stationary random processes during the use of standard equipment of analog computers. Author

N67-34243# General Electric Co., Philadelphia, Pa.
A TECHNIQUE FOR AUTOMATING ROOT LOCUS CALCULATIONS ON DIGITAL COMPUTERS
Richard M. Klein Dec. 1962 62 p refs
(TIS-66SD308)

The technique involves a solution for the points of instability by use of a unique three-dimensional Routhian array. Break points are solved for and the locus is then plotted by either axis translation or by selecting intervals between the break and crossover points. A Fortran IV program, written for the IBM 7094 computer, utilizing the technique is also included. The input to this program is the open-loop transfer function, and user manipulation of gain factor is not required. Author

N67-34274*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A PROGRAM FOR LISTING OF OGO ATTITUDE ORBIT TAPES
Henry G. Linder Aug. 1967 41 p
(NASA-TM-X-55879; X-565-67-372) CSCL 09B

The program was prepared in order to list orbit numbers and start and stop times of orbits on attitude orbit tapes that were produced for the OGO mission. The OGO spacecraft employs an on-board automatic control system and a digital computer program computes the attitude and the orbital position of the OGO spacecraft for later correlation with experimental data. The program produces attitude orbit tapes as an output and each OGO experimenter receives copies of it. During the lifetime of each OGO spacecraft a large number of attitude orbit tapes have been sent to each experimenter. Sometimes corrections and updates of tapes are also sent to each experimenter increasing the total number of tapes on hand. The large volume of tapes and the ordering of updated tapes created a need for cataloguing all available tapes. Therefore, a computer program was prepared to list all available tapes on hand and this information was sent to each OGO experimenter in order to establish and maintain a complete library of OGO attitude orbit tapes. The design of that computer program and its usage are described. Author

N67-34283*# Bellcomm, Inc., Washington, D. C.
STATE-OF-THE-ART OF AEROSPACE DIGITAL COMPUTERS, 1962–1967
D. O. Baechler 22 Jun. 1967 37 p refs
(Contract NASw-417)
(NASA-CR-87173; TM-67-1031-1) CFSTI: HC $3.00/MF $0.65 CSCL 09B

The information is based on the characteristics of aerospace computers which were developed during the period 1962–1967. Data were obtained from manufacturers and from two previous surveys. No attempt is made to extrapolate the information in the survey to describe the characteristics of post-1967 computers. The memorandum is slightly biased toward manned space flight applications, particularly when discussing future research trends. Characteristics of the major functional subdivisions of a computer—the memory, the input/output, and the central processing unit are summarized. Operational and physical characteristics including speed, software, reliability, and weight, power, and volume are presented. Some areas where progress in existing technology is likely to occur or might be needed to handle the requirements of future missions are outlined. Author

N67-34292# RAND Corp., Santa Monica, Calif.
SOVIET CYBERNETICS: RECENT NEWS ITEMS, NO. 5
Wade B. Holland, ed. Jun. 1967 102 p refs
(P-3600/5; TT-67-62138; AD-653937) CFSTI: HC $3.00/MF $0.65

Content: Systems at > one billion opns/sec: outline of a new direction for Soviet computer development; Minsk-222; The M-220: description and photograph; Gvishiani discusses management science and systems analysis; Rednev interviewed on university-industry cooperation; Mathematicians propose sabbaticals, foreign exchanges; Ob data transmission system; More emphasis needed on scientific data processing; Computer malfunction diagnostics; Organization of computer production criticized; photo of VNIIEM-3; Soviet science in the Ukraine: historical survey; More on the Vilnyus calculator controversy; Cybernetics in transcaucasia: survey; Articles and photographs in the Soviet press, May 1967. TAB

N67-34314# Battis Atomic Power Lab., Pittsburgh, Pa.
WIGL2 ADDENDUM 1: A PROGRAM FOR THE SOLUTION OF THE ONE-DIMENSIONAL, TWO-GROUP, SPACE-TIME DIFFUSION EQUATIONS ACCOUNTING FOR TEMPERATURE, XENON, AND CONTROL FEEDBACK
A. F. Henry and A. V. Vota Jan. 1967 5 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-532, Addend. 1) CFSTI: HC $3.00/MF $0.65

A description is given of the modifications of WIGL2, a one-dimensional, two-group, space-time diffusion theory program written in Fortran II and compiled on the Philco-2000. The program was converted to Fortran IV and compiled on the CDC-6600 with the changes described. Author (NSA)

N67-34316 United Kingdom Atomic Energy Authority, Harwell (England). Ceramics Div.
CELFIT—A COMPUTER PROGRAM TO REFINE CRYSTAL UNIT CELL DIMENSIONS
B. H. Bracher Apr. 1967 31 p
(AERE-R-5412) HMSO: 4s

This report describes a computer program, written in Fortran, for the refinement of the unit cell parameters of a crystal. The method of refinement is described, and details of input formats are given. Author

N67-34557 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE USE OF ORDERED TEXTS FOR EXTENDING THE POSSIBILITIES OF READING DEVICES
V. S. Fayn *In its* Probl. of Inform. Transmission 31 Jan. 1967 p 70–83 (See N67-34552 20-07)

The question of the essence and ways of using orderliness in texts in automatic readers is discussed as orderliness applies to the text as opposed to individual letters. It is established that it is possible to increase the reliability of recognition and essentially reduce the set of standards for reading a large number of different types by using the orderliness mentioned above. Such factors as the high probability of the appearance of all letters in a given text sample in the same type; the straightness of lines; the strict parallelism of lines; and the high degree of standardization of kinds of type having the same name used by various publishers can be used for this purpose. Author

N67-34577# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
CONVERSION OF THE NEUTRON CODE TDC TO FORTRAN IV
B. McGregor Feb. 1967 9 p refs
(AAEC/TM370)

The conversion of the code TDC from CDC 1604 Fortran to Fortran IV is discussed with some notes on additional options provided. A series of test problems was devised and run and some points on code usage are reported. The preparation of input data is not described. Author

N67-34602# United Kingdom Atomic Energy Authority, Harwell (England). Electronics and Applied Physics Div.
MEAN RATE ANALYSIS WITH THE PDP8 COMPUTER
G. C. Best and I. N. Hooten Mar. 1967 25 p refs
(AERE-R-5425) HMSO: 3s

The technique of mean-rate analysis for multiparameter data is discussed and shown to be particularly suitable for small computer application. Details of a PDP8 mean-rate analyser are given, with operating instructions and complete program listing. Author

N67-34668* Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
RESEARCH STUDIES OF RANDOM PROCESS THEORY AND PHYSICAL APPLICATIONS
George W. Bordner, Charles J. Greaves, and Walter W. Wierwille 4 Aug. 1965 127 p refs
(Contract NAS8-11346)
(NASA-CR-61081) CFSTI: HC $3.00 CSCL 09B

Many techniques of processing of random data have been presented which can be applied to engineering problems. Techniques

for estimating correlation functions and power spectral densities for all classes of random processes, including nonstationary, stationary, gaussian bivariate, etc., in addition to deterministic processes have been described in a rigorous mathematical sense. Further aids to the processing techniques are also given. These include a complete thesis on the synthesis of optimal digital filters, including low-pass, high-pass, band-pass, and notch filters. The technique of digital heterodyning is also presented. To further aid the processing engineer methods of applying the techniques on a general purpose digital computer are presented. For the previously unproven processing techniques presented, experimental verification is given. Author

N67-34774*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SCIENCE DATA SYSTEMS
In its Space Programs Sum. No. 37/45, Vol. IV 30 Jun. 1967 p 222-234 refs (See N67-34761 20-30)

Details are given on a video film converter that either exposes or reads 35- or 70-mm film with high fidelity (less than 1 m. 1 spot) by means of a flying spot scanner. Applied to video data processing, descriptive details are given on the controls, format generation, deflection, focus, intensity, and camera control. Equations are derived for the cycle length versus initial state for linear feedback shift registers. Electrical and mechanical characteristics are defined for a low-power, nondestructive readout memory to meet science mission requirements. The information is stored in a woven plated wire matrix which is a cloth-like array of fine copper wires. Schematics show the plating line, binary digit, shaped drive fields, word drive current, digit current, engineering model for the memory system, the timing block, system timing, and read signal selection. M.G.J.

N67-34987# Stanford Univ., Calif. Linear Accelerator Center.
SYSTEM DESIGN FOR CRT FILM SCANNING AND MEASURING
W. F. Miller and J. Van der Lans Apr. 1967 9 p Presented at the 8th Natl. Symp. of the Soc. for Inform. Display, San Francisco, May 1967
(Contract AT(04-3)-515)
(SLAC-PUB-300; CONF-670515-1) CFSTI: HC$3.00/MF$0.65

Devices have been developed for digitizing spark-chamber and bubble-chamber films generated in high-energy physics experiments. The devices are connected to an IBM 360/50. A description is given of the spot generator, control and data transfer, and scanning and digitization. Finally, some of the differences between the digitizers (Hummingbird I and II) are discussed. NSA

N67-35180# American Mathematical Society, Providence, R. I.
EXTENSION OF THE SYSTEM OF PREPARING A COMPUTER-PROCESSED TAPE TO INCLUDE THE SETTING OF MULTIPLE LINE EQUATIONS
Jul. 1967 42 p refs
(Grant NSF GN-533)
(Rept.-2)

The basic approach described is to program a standard input language which is unambiguous, and to include a preprocessor, to translate input printing symbols into characters on the composition machine, and a typesetter, to process symbols under complex typographical situations. Details are given on existing proposed languages, and alternative methods of composition are considered. An example is included of a manuscript and resulting photon composition with the intermediary language, modified language, and verbalization steps. N.E.N.

N67-35192*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FORTRAN IV PROGRAM FOR CALCULATION OF THERMODYNAMIC DATA
Bonnie J. McBride and Sanford Gordon Washington, NASA, Aug 1967 135 p refs
(NASA-TN-D-4097) CFSTI: $3.00 CSCL 20M

A FORTRAN IV program is described which (1) calculates thermodynamic functions (heat capacity, enthalpy, entropy, and free energy), (2) fits these functions to empirical equations, and (3) calculates, as a function of temperature, heats of formation and equilibrium constants. The program provides several methods for calculating ideal gas properties. For monatomic gases, three methods are given which differ in the technique used for truncating the partition function. For diatomic and polyatomic molecules, five methods are given which differ in the corrections to the rigid-rotator harmonic-oscillator approximation. In addition the program provides for calculating thermodynamic function for solids, liquids, and gases from empirical heat capacity equations. Author

N67-35203# Stanford Univ., Calif. Stanford Linear Accelerator Center.
TWO-DIMENSIONAL PATTERN DESCRIPTION AND RECOGNITION VIA CURVATURE POINTS
C. T. Zahn Dec. 1966 114 p refs
(Contract AT(04-3)-515)
(SLAC-70) CFSTI: HC$3.00/MF$0.65

A method is presented for obtaining structural descriptions of that class of two-dimensional pictures whose elements are a finite set of points in the plane each having value zero (white) or one (black). The points are arranged in the form of some uniform lattice or grid system. It is assumed that the pictures are black and white points arranged on a square lattice of N^2 points; an example of such a picture on a 32×32 square lattice is included. The structural description employed consists of a set of simple polygonal closed curves whose vertices are ordered in either clockwise or counter-clockwise sense. These curves represent the continuous boundaries between connected sets of black points, called objects, and connected sets of white points, termed holes. The construction of a recognition algorithm for a stylized alphabet is considered, and the Algol 60 procedures for finding and linking curvature points are included. M.G.J.

N67-35204# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
ANALOGUE-DIGITAL-MAGNETIC TAPE CONVERSION SYSTEM
J. R. Morrey and H. S. Gile (Computer Sci. Corp.) May 1967 198 p
(Contract AT(45-1)-1830)
(BNWL-343) CFSTI: HC$3.00/MF$0.65

Descriptive details are given on the conversion system which consists of instrumentation for recording analog data on paper tape and transferring it to magnetic tape; computer programs for editing and transferring the data from the paper to the magnetic tape; and a general computational program for performing a variety of calculations on the data. A flow chart and schematics are included. Author

N67-35242# Comissao Nacional de Atividades Espaciais, Sao Jose Dos Campos (Brazil). Lab. de Fisica Espacial.
SIMULATION [SIMULACAO]
Luiz Celso de Moraes Machado (M.S. Thesis—Inst. Technol. de Aeron.) Jan. 1967 127 p refs In PORTUGUESE; ENGLISH summary.
(LAFE-53)

Digital simulation techniques and a classification of basic simulation problems of flow systems and production systems, in addition to methods of generating stochastic variables (a pseudo-random number generation), are discussed. Included also are: an introduction to simulation languages, a comparative study of general purpose languages (Fortran-AFIT), a special purpose

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

language (IBM's GPSS-II with an example problem), and a semiautomatic language for the IBM-1620 computer—LESS. This language provides easy access to the system and a possibility of executing the source program itself without the compilation passes. The concept of PHRASE and a chance of program modification without a new pass is one of the advantages of the system. A technique for solving simulation problems is described with illustrative examples. A user's manual as well as a characteristics manual are included as supplements. Author

N67-35243 Royal Aircraft Establishment, Farnborough (England).
THE REALISATION OF PRACTICAL GENERAL PURPOSE COMPUTERS WITH THE MINIMUM OF HARDWARE
D. Stone Nov. 1966 83 p refs
(RAE-TR-66355)

A means of making low cost general purpose computers is described. The technique employed makes use of a brief and elementary order code which does not include arithmetical instructions. When required, arithmetical operations can be performed by means of sequences of minimal instructions. The computing power of such a machine is shown to be greatly increased by the aid of a few special locations in the core store able to perform logical operations on quantities passed through them. Author

N67-35251*# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.
ERASABLE MEMORY INVESTIGATIONS Final Report
D. Shansky Mar. 1967 34 p
(Contract NAS9-4065)
(NASA-CR-65713; E-2099) CSCL 09B

Work proceeded in four distinct areas: plating of wire; development of inexpensive solenoidal word line coils, circuit design aimed at producing an operable plated wire memory based on the Toko memory stack which had been acquired; and electronic instrumentation and controls for the wire plating line. The plating line has been completely redesigned and rebuilt to allow for more precise control of the movement of the wire through the various baths. Controls have been provided for temperature, flow rate, plating current, and pH, and a spectrophotometer has been acquired to permit more precise control of solution composition. The plating line produces wire of controlled composition suitable for use as the storage element in an NDRO memory. An exerciser for the Toko memory permits the selection of any word in a 4096-word memory and has the capability of providing disturb signals on either side of the selected word an arbitrary number of times. Author

N67-35293 Joint Publications Research Service, Washington, D. C.
STOCHASTIC MODELS OF OPERATION OF ASYNCHRONOUS DIGITAL COMPUTERS
Ye. K. Degtyarev *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 133–149 refs (See N67-35281 20-10)

A two-phase queueing system is studied, with group servicing in one of its circuits, which is a model of some special features of operation of an asynchronous digital computer. The semi-Markov process connected with the system is investigated with application of the recurrent polynomials introduced in the work. Expressions are obtained for probabilities of the states and the average time of servicing of one demand in the system with different disciplines of group servicing corresponding to the different special features of operation of the asynchronous digital computer. Author

N67-34000# Speer Carbon Co., Niagara Falls, N. Y.
RESISTORS FOR MICROPOWER CIRCUITS Final Report, 1 Jul. 1965–31 Dec. 1966
Charles F. Parks May 1967 53 p refs
(Contract DA-28-043-AMC-01524(E))
(SCC-27; R-152; Rept.-6; ECOM-01524-F; AD-653630) CFSTI: HC $3.00/MF $0.65

Micropower resistors of 4.7, 10, 22, 47, and 100 megohms resistance have been prepared, tested and delivered. The resistors, including substrate, were processed from raw materials to the finished product. Substrates were pressed, fired, and centerless ground to less than 50 mils diameter. Thallium oxide glaze resistive films were applied and fired, and were then helixed to the desired resistance values. Lead wires were attached by percussive welding, and a conformal silicone coating was applied as an encapsulation. The resulting miniature resistors are mechanically strong and have generally good to excellent electrical properties. Some instability problems were encountered with the 4.7 megohm samples prepared initially, but these were generally corrected in the higher value resistors. The resistance temperature characteristic performance of the 10 to 100 megohm resistors was in the range of -100 to -250 ppm/C, outside of the limits prescribed in the technical guideline. Problems were also encountered in resistance tolerance at 100 megohms, terminal strength, resistance to solder heat, and resistance at 10 MC of the 47 and 100 megohm units. In all other tests, however, including temperature cycling, low temperature operation, moisture resistance with and without power, voltage coefficient, current noise, stray capacitance and 1000 hour load life, satisfactory performance was demonstrated at all specified resistance levels. Author (TAB)

N67-34058# Illinois Univ., Urbana.
A CATHODE RAY TUBE DISPLAY
Jack Stifle Jun. 1967 40 p
(Contract DA-28-043-AMC-00073(E))
(R-357; AD-653525) CFSTI: HC $3.00/MF $0.65

The report describes a cathode ray tube display unit designed for use as graphic output facility for a digital computer. The display features a self-contained character generator, line generator, photographic unit, and a light pen. Data may be displayed in up to seven different modes. The maximum plotting rate is approximately 333,000 points/sec. Author (TAB)

N67-34059# Harry Diamond Labs., Washington, D. C.
COMPONENT EVALUATION DURING SHOCK
A. J. Buschman, Jr. May 1967 37 p refs
(HDL-TM-67-7; AD-653533) CFSTI: HC $3.00/MF $0.65

A test method was developed that allows direct wire monitoring of an item during application of shock. The method employs the air gun facilities of HDL. The test item is mounted in a target body that is impacted by the air gun projectile. Peak accelerations of 20,000 g with a duration of 0.75 msec were obtained. The components evaluated, primarily resistors and capacitors, showed very small dynamic changes. Author (TAB)

N67-34061# General Electric Co., Schenectady, N. Y. Research and Development Center.
VERY LOW FREQUENCY CAPACITANCE BRIDGE

S. Roberts Sep. 1966 4 p ref
(Rept.-66-C-333)

A four arm capacitance bridge employing an operational amplifier is described, which is capable of measuring small capacitors of a few picofarads with high accuracy. This bridge has been used at frequencies from 0.01 to 10 Hz and at static voltages up to 5 kv. Author

N67-34066# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
CYCLOTRON WAVE POWER CONVERTER
D. C. Watson, K. I. Talbot, and C. C. Johnson Mar. 1967 81 p refs
(Contract DA-36-039-AMC-02372(E))
(EC-4; UTEC-MD-67-009; AD-654049) CFSTI: HC $3.00/MF $0.65

The cyclotron-wave power converter is useful over the same frequency range as the Cuccia coupler. Its theoretical power-handling capability is very high, of the order of megawatts for a wide-gap Cuccia cavity and a few amperes beam current. Theoretical efficiency ranges from 0.60 to over 0.95, depending on power ratio, transistion length, the type of collector, and the final value of the B-field. These results are summarized. Measured efficiencies have been significantly lower, due mainly to difficulties associated with collector current reduction under r-f conditions with depressed collector voltage. Author (TAB)

N67-34129# Army Electronics Labs., Fort Monmouth, N. J.
METAL–VANADIUM PENTOXIDE–SILICON DIODES WITH HIGHLY VARIABLE CAPACITANCES
Charles McAfee Apr. 1967 24 p refs
(ECOM-2815; AD-654133) CFSTI: HC $3.00/MF $0.65

Large-area metal-metal oxide-semiconductor diodes (top contact diameter = 1.6 mm) have been fabricated by evaporating vanadium pentoxide, V2O5, on carefully prepared surfaces of 12-ohm-cm n-type silicon wafers, firing at 700C, evaporating nickel for contact to the oxide, and chemically depositing nickel on the sub-surface of the silicon wafer to achieve ohmic contact to the silicon. Reverse breakdown of the diodes was 80 volts or higher, varying with oxide thickness and care in surface preparation. Capacitance variation with frequency at zero bias was determined over the range 15 kHz - 5 MHz. The data showed a decrease in capacitance with frequency from 2.750 nF at 15 kHz to 0.250 nF at 5 MHz. Capacitance variations with bias for various frequencies over the range 100 kHz - 5 MHz were also determined. For the frequency range, 100 kHz - 2 MHz, capacitance increased with forward bias, attained a maximum value in the interval 0.3 to 1.5 volts above zero bias, and decreased thereafter with increased forward bias. Each peak capacitance value occurred at successively lower forward bias values as frequency increased. Capacitance ratios greater than 60:1 were obtained for the frequency range 100 kHz through 1 MHz with more than 60% of the change occurring within the interval 0.4 to 0.6 volts reverse bias. Author (TAB)

N67-34192# Institut für Plasmaphysik G.m.b.H., Garching (West Germany).
ENERGY STORAGE CAPACITORS [IMPULSKONDENSATOREN]
R.-C. Kunze Apr. 1967 21 p In GERMAN; ENGLISH summary
(IPP-4/35) CFSTI: HC $3.00/MF $0.65

In fast current devices (e.g. thetapinch) the capacitive energy storage system is subjected to different load conditions according to the current program. Causes for faults in impulse capacitors are discussed, and possibilities of increasing the capacitor life are investigated. A survey of properties of impulse capacitors is also given. Author

N67-34198# Hughes Research Labs., Malibu, Calif.
3.2 MILLIMETER WAVE OSCILLATOR Quarterly Progress Report, 1 Jan.–31 Mar. 1967
Robert P. Bryan Jul. 1967 23 p ref
(Contract DA-28-043-AMC-02225(E))
(ECOM-02225-2; QPR-2; Rept.-7; AD-654032) CFSTI: HC $3.00/MF $0.65

This program involves the development of a permanent magnet focused 10 kW pulsed distributed interaction klystron which oscillates at 93.75 GHz and has been both environmentally and life tested. It is believed that this objective may be reached when the necessary improvements are made in an Exploratory Development Model tube developed under a previous contract. A permanent magnet weighing less than 25 lb should be possible. In addition, it is indicated that a higher perveance electron gun will be required to realize a higher efficiency with a shorter cavity structure tube; further efforts to improve the efficiency of the tube have been suspended. Studies indicate that the use of an electron gun with an interception grid to modulate the beam current is feasible. Construction of test diodes, tube subassemblies, and the short pulse modulator continues. Author (TAB)

N67-34253# Northrop Corp., Newbury Park, Calif. Applied Research Dept.
GENERALIZED MODEL FOR SEMICONDUCTOR RADIATION RESPONSE PREDICTION Final Report, 15 Dec. 1964–14 Mar. 1967
James P. Raymond and Robert E. Johnson Jun. 1967 170 p refs
(Contract DA-28-043-AMC-00423(E))
(ARD-67-21R; Rept.-8; ECOM-00423-F; AD-654134) CFSTI: HC $3.00/MF $0.65

The lumped model technique of representing semiconductor device response to radiation was applied to diodes, bipolar transistors and integrated circuit elements. The lumped model formalism was first developed by approximating the equations governing electron and hole flow in a semiconductor, and the feasibility of the technique was established by the representation of diodes and transistors. The analysis was then extended to the detailed large-signal response and saturated storage time of the bipolar transistor and monolithic transistor element, and the general form of the monolithic diffused resistor element. With the use of computer aids, the electrical and radiation response of these devices was calculated solely from electrical and geometrical parameters. The lumped model technique has been established as an accurate, practical, and straight-forward method of deriving the mathematical model for a semiconductor device, calculating the electrical and ionizing radiation-induced transient response, and predicting the parameter degradation of displacement damage. Representation of the discrete bipolar transistor, and the bipolar transistor and resistor junction-isolated monolithic integrated circuit elements establish the necessary basis for the analysis of integrated circuits. Author (TAB)

N67-34262# Hughes Research Labs., Malibu, Calif.
MAGNETIC COMPRESSION OF ELECTRON BEAMS Quarterly Report, 1 Jan.–31 Mar. 1967
Kurt Amboss Jun. 1967 43 p refs
(Contract DA-28-043-AMC-01463(E))
(Rept.-7; QR-7; ECOM-01463-7; AD-653793) CFSTI: HC $3.00/MF $0.65

The objective of this program is to compress a perveance 0.54×10 to the −6th power A/V raised to the 3/2 power electron beam by a factor of 1000 and to gain an understanding of the behavior of the compressed beam. Magnetic compression has been demonstrated with a short field buildup provided by a simple pole-piece. If a similar result can be achieved with a much denser beam, magnetic compression will provide an attractive

method of obtaining beams of the required size. Highly compressed beams with moderate amounts of space charge take on an almost gaussian appearance after compression; this can be explained by assuming that the transverse energy is primarily in rotation. The beam has an effective transverse temperature TB given by TB=TCAC where TC is the cathode temperature and AC is the area compression of the beam. TAB

N67-34270# Minnesota Univ., Minneapolis. Electron Tube Research Lab.
NOISE MEASUREMENTS AS A TOOL IN ELECTRON DEVICE RESEARCH Triannual Technical Report, 1 Oct. 1966–31 Jan. 1967
A. van der Ziel Ft. Monmouth, N. J., Army Electron. Command, May 1967 41 p
(Contract DA-28-043-AMC-01880(E))
(ECOM-01880-3; AD-653653) CFSTI: HC $3.00/MF $0.65

The paper contains a study of noise in secondary electron conduction vidicons and in channel multipliers. In image intensifiers the noise is somewhat larger than the amplified shot noise of the primary current and drops to full shot noise of the amplified current at high frequencies. More noise measurements are reported in transmission secondary electron multipliers. At high gains the output becomes noisy, and the noise consists of spikes in the output current; this is attributed to breakdown in the KCl layer. A theoretical interpretation of the observations is given. A detailed study is made of noise in television pick-up devices. The cases discussed are: uniform illumination; single picture is illuminated, electron picture is scanned over an aperture, long integration time and short sweep time devices with multiplication between photocathode and target. Author (TAB)

N67-34271# Syracuse Univ., N. Y.
HETEROJUNCTION DEVICES
Richard L. Anderson, Girtz Zeidenbergs, and Thomas Huang Griffiss AFB, N. Y., RADC, May 1967 139 p refs
(Contract AF 30(602)-3637)
(RADC-AR2-66; RADC-TR-67-74; AD-654001) CFSTI: HC $3.00/MF $0.65

Heterojunctions were prepared by depositing Si epitaxially onto GaAs and GaP substrates using silicon-tellurium compounds as transporting agents. The experimental results are in agreement with the abrupt junction theory for heterojunctions. A quantitative discussion is given for electron tunneling through a Schottky Barrier. An open tube deposition system is described for use in the epitaxial deposition of III-V compounds. Associated water transport problems are discussed. Improvements have been made on a closed tube epitaxial system. A phenomelogical model of the transport and deposition has been formulated which predicts that the ampoule geometry has an appreciable influence on the deposition and may be used as a parameter in the design of an epitaxial system. Author (TAB)

N67-34282# Sylvania Electric Products, Inc., Towanda, Pa. Chemical and Metallurgical Div.
RESEARCH AND DEVELOPMENT OF CATHODOLUMINESCENT PHOSPHOR WITH EXCITATION-TIME-DEPENDENT COLOR Final Report, 1 Jul. 1963–15 Aug. 1966
F. F. Mikus and B. W. Van Noy Apr. 1967 135 p refs
(Contract DA-36-039-AMC-03228(E))
(Rept.-10; ECOM-03228(E)-F; AD-654040) CFSTI: HC $3.00/MF $0.65

The development of a cathode-ray tube with excitation-time-dependent color for moving-target indication included studying various phosphors and phosphor combinations. Techniques for evaluating the cathode-ray characteristics of various phosphors and different methods of radar simulation were developed. Most of the phosphor work involved studying long decay phosphor systems, such as, manganese and rare-earth activated fluorides, copper activated sulfides, and rare-earth activated oxide phosphors. Mixed and cascaded screens were prepared using the most promising phosphors from the investigation. Because insufficient improvement was obtained from conventional phosphors and screening techniques, an electron-beam-barrier approach was tried. Various methods were attempted to introduce a layer of material opaque to electrons and transparent to UV and visible light between two phosphor layers. The barrier enabled utilization of the longer decay of ZnS:Cu when excited by UV light instead of cathode rays. The optimized tube exhibited excellent color contrast between fixed and moving targets for fast scan radar systems using more than six scans per second, but further development is needed for slower scan rates. TAB

N67-34305# International Business Machines Corp., Owego, N. Y. Electronics Systems Center.
RADIATION EFFECTS ON ELECTRONIC PARTS AND MATERIALS Quarterly Report, 15 Dec. 1966–14 Mar. 1967
Frank A. Frankovsky Army Electron. Command, Ft. Monmouth, N. J. May 1967 29 p refs
(Contract DA-28-043-AMC-02374(E))
(Rept.-9; QR-3; ECOM-02374-3; AD-653795) CFSTI: HC $3.00/MF $0.65

Results of mica and polystyrene capacitor irradiations at an Advanced Flash X-Ray source are presented in this quarterly report. Expressions have been developed for analyzing the conductivity effect as a result of the ionizing radiation from X-rays of 5-MeV energy at pulse durations of 30 to 100 nanoseconds. Characteristic parameters derived from these expressions are discussed in this report. These parameters show a good consistency over different variations of voltage, dose, and temperature. Author (TAB)

N67-34530# Autonetics, Anaheim, Calif.
RADIATION EFFECTS ON THIN-FILM INTEGRATED CIRCUIT ELEMENTS Quarterly Report, 15 Jan. 1966–14 Apr. 1967
V. H. Strahan, A. J. Chesavage, and D. K. Nichols Jun. 1967 27 p refs
(Contract DA-28-043-AMC-02431(E))
(Rept.-7; QR-2; ECOM-02431-2; AD-653623) CFSTI: HC $3.00/MF $0.65

The efforts of this quarter were directed toward calculating and measuring FXR radiation induced charge in a thin aluminum film (3810 A) deposited on a 0.032 inch insulating substrate. The relative importance of the mechanisms for inducing a charge and the influence of a bias voltage on the conductor were analyzed. The net charge change on the sample is the difference between the deposition and the emission in the sample of Compton electrons and secondary electrons. The net charge change from secondary electrons is approximately twice that from Compton electrons. A bias voltage in excess of plus or minus 60 volts on the thin-film conductor controls the net charge changes from secondary electrons but does not influence the Compton electrons. The geometry of the experiment affects the electron to gamma ratio of the incident beam which results in a value for the net charge change applicable to the specific experiment only. TAB

N67-34648# Texas Instruments, Inc., Dallas. Semiconductor-Components Div.
INTEGRATED CIRCUITS FOR PORTABLE RADAR EQUIPMENT Quarterly Report, 1 Dec. 1966–28 Feb. 1967
E. Clayton Teague, Stacy B. Watelski, C. Dennis, and L. Sharif Jun. 1967 38 p refs
(Contract DA-28-043-AMC-02029(E))
(TI-03-67-31; QR-4; Rept.-4; ECOM-02029-4; AD-653628) CFSTI: HC $3.00/MF $0.65

The results of experiments on factors determining the surface structure and topography of the germanium growth front during selective etch and deposition in GaAs are summarized. Experimental data have been obtained which show that preferential growth near the pocket edges can be eliminated by partially refilling the etched regions. The surface topography of the selectively deposited germanium is determined primarily by the substrate temperature and the GeCl4 concentration. The device to be fabricated in the Ge pockets is described. Author (TAB)

N67-34884# Aeronautical Research Council (Gt. Brit.)
FEED-BACK ACCELEROMETER CIRCUITS WITH A VELOCITY OUTPUT
R. H. Evans and G. G. Haigh 1967 31 p refs Supersedes RAE-TR-64005; ARC-26819; See X65-15417
(ARCR&M-3462; RAE-TR-64005; ARC-26819) CFSTI: HC $3.00/MF $0.65

Circuits are suggested for modifying the feed-back loop of an accelerometer so that the output voltage is proportional to velocity, that is, an integrating process is incorporated within the loop. The main advantage is that the indicated velocity should be less critical with respect to amplifier drift than in most existing methods of integration. Circuit design is treated in some detail for typical examples of force feed-back accelerometers, including both undamped and viscous damped types, and it is shown that acceptable accuracy and stability should be possible with either type. A comparison is made with other methods of integration, and it is concluded that the method may find application, for example, as part of an analogue inertial navigation system, but that other methods are likely to be preferred in systems incorporating digital computers. Author

N67-34785*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GUIDANCE AND CONTROL RESEARCH
In its Space Programs Sum. No. 37-45, Vol. IV 30 Jun. 1967 p 42-56 refs (See N67-34761 20-30)

To increase the output voltage of a thermionic energy converter, a method is described whereby ions are produced in the electrode space using principles similar to those which govern the Penning-type discharge. An experimental cesium diode was designed with electron emitting side walls in addition to the planar part of the emitter. A magnetic field is applied externally with its direction normal to the planar surface. Experimental data on volt-ampere characteristics are given. Noise in unipolar space charge limited current (SCLC) in solids is considered, and it is pointed out that there is at least one limiting case of operation of SCLC in a solid in which shot noise may be suppressed little, if at all, and for which no analogous situation exists in vacuum. An approach for achieving control and modulation of SCLC in solid state triodes is discussed to show the feasibility of accurately cutting channels into which gate conductors can be alloyed. A comparison is drawn between recrystallized evaporated thin films of photoconducting CdS and CdS photodetectors used on spacecraft. Response times and sterilizability of the recrystallized layers are considered superior. M.G.J.

N67-34894*# Hughes Aircraft Co., Newport Beach, Calif. Applied Solid State Research Dept.
RESEARCH FOR DEVELOPMENT OF THIN-FILM SPACE-CHARGE-LIMITED TRIODE DEVICES
Kenneth G. Aubuchon, Peter Knoll, and Rainer Zuleeg May 1967 77 p refs
(Contract NAS12-144)
(NASA-CR-87492) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Silicon-on-sapphire space-charge-limited triodes were designed and fabricated. The silicon films were grown on sapphire (α-Al_2O_3) wafers by the pyrolysis of silane (SiH_4) at temperatures between 1000° and 1150°C and were investigated by X-ray diffraction methods and by Hall effect measurements. The films with the best structural perfection, having hole mobilities of essentially single crystal silicon, were grown at 1050°C. Higher as well as lower pedestal temperatures resulted in a poorer deposit. The high temperature limitation for the film growth apparently is due to a chemical reaction between silicon and sapphire which is enhanced with increasing temperature. The films used for device fabrication were p-type and were polished to 2μ thickness. The SCL-triodes are similar to off-set gate n-channel MOS transistors and the processing is the same except for an initial masking step which isolates silicon islands on the sapphire substrate. The feed-back capacitance of the SCL-triodes was calculated to be 0.12 pf, and the TO-5 headers contribute an additional 0.2 pf. The maximum frequency of oscillation obtained was 3 to 4 GHz for a source-drain spacing of approximately 4μm. Higher frequencies should be obtainable with further reduction in source-drain spacing. Both enhancement and depletion mode devices were obtained. It is shown that a higher frequency response is expected from the positive gate (enhancement mode) operation. Results of radiation tests with doses up to 2×10^5 rad are presented, along with comparative tests on MNS and MOS capacitors which indicate that silicon nitride is much less sensitive to ionizing radiation than SiO_2. Author

N67-34911 Tektronix, Inc., Beaverton, Oreg. Electronic Instrumentation Group.
A PRACTICAL APPROACH TO TRANSISTOR AND VACUUM TUBE AMPLIFIERS. PART 3: A DC ANALYSIS OF A TYPICAL TEKTRONIX HYBRID CIRCUIT
F. J. Beckett Jun. 1967 7 p
(Rept.-44)

A vertical amplifier of a Type 545B Oscilloscope was selected as a representative hybrid circuit to demonstrate a dc analysis approach that is practical for dealing with transistor and vacuum tube amplifiers. While there are limitations to the approach, it is considered to be a direct method of trouble shooting and understanding circuits. An entire circuit analysis is presented, with the input circuit as the point of entry; although any point of entry that will result in useful information is considered usable. M.W.R.

N67-34990# Sandia Corp., Albuquerque, N. Mex.
SINUSOIDAL STEADY-STATE CHARACTERISTICS OF MULTIELECTRODED PIEZOELECTRIC DEVICES
E. P. EerNisse and Richard Holland Apr. 1967 11 p refs Presented at the Freq. Control Symp., Atlantic City
(Contract AT(29-1)-789)
(SC-DC-67-1731; CONF-670415-1) CFSTI: HC $3.00/MF $0.65

A tractable technique for analyzing the circuit behavior of mechanically free, multielectroded, three-dimensional, piezoelectric devices was developed by describing the steady-state operation by a stationary Lagrangian. It has been shown that the approximation techniques of variational calculus can be used to evaluate either the short-circuit or the open-circuit resonant modes of piezoelectric structures. The calculus of variations is used to show how to obtain an admittance matrix for a device once the short-circuit resonant modes are known, or, how to obtain an impedance matrix for a device once the open-circuit resonant modes are known. To illustrate these concepts, numerical results are presented for the admittance matrix of dot-ring electroded piezoelectric ceramic discs with comparable diameter and thickness dimensions. Author (NSA)

N67-35276 Joint Publications Research Service, Washington, D. C.
THE AVALANCHE-DRIFT DIODE AND ITS USE IN MICROWAVE ENGINEERING

A. S. Tager 1 Jul. 1967 47 p refs Transl. into ENGLISH from Vsp. Fiz. Nauk (Moscow), v. 90, no. 4, Dec. 1966 p 631–666 (JPRS-47678; TT-67-32310) CFSTI: $3.00

The characteristics of the avalanche-drift diodes (ADD) are discussed in detail, and ADD-type devices are described. The operating principles of semiconductor diodes with dynamic negative resistance are reviewed, and the advantages of the ADD are indicated. A number of engineering and design studies on ADD and active UHF devices incorporating them indicated the best results could be obtained with the germanium diodes. Several ADD were developed with the improved diffusion technology and were utilized for the development of oscillators of coherent oscillations, small quartz-type multiplying circuits, regenerative amplifiers of microwave and millimeter wave bands, and miniaturized sources of UHF noise. N.E.N.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N67-34010# Industrial Science and Technology Agency, Tokyo (Japan). Electrotechnical Lab.

STAR-CONNECTED 11.4 kV DISTRIBUTION SYSTEM

Yoshinori Sakamoto Dec. 1966 101 p refs *Its* Res. of the Electrotech. Lab. No. 671

CFSTI: HC $3.00/MF $0.65

Technical problems on star-connected 11.4 kV distribution systems are described. The author classifies the systems into three categories according to the neutral grounding method for the convenience, (1) single low resistance grounded neutral system, (2) single high resistance grounded neutral system and (3) multi-grounded system. The general properties of these systems have been examined through the theoretical investigations and the numerical calculations. The numerical calculations are performed on the fault voltage of low voltage circuit and the sound phase voltage of high voltage circuit during faults in the Y 11.4 kV single-point neutral grounded system. The voltage rises of the high voltage circuit and low voltage circuit, fault current and current distribution in neutral wire during fault were examined on a multigrounded system. The general formulas of these quantities are derived on the system, and the numerical calculations are performed on the digital computer. The arresters applied on the Y 11.4 kV distribution system are studied, and the permissible limit of the voltage rise of the low voltage circuit during fault and test voltage applied to the distribution systems are investigated. Author

N67-34188# Tokyo Univ. (Japan). Inst. of Industrial Science.

THEORY AND APPLICATIONS OF IMICTRON: A CONTROL ELEMENT HAVING MECHANISMS OF A LIVING NEURON

Shuhei Aida Mar. 1967 93 p refs *Its* Vol. 17, No. 5, Serial No. 112

CFSTI: HC $3.00/MF $0.65

Definitions, assumptions, and historical backgrounds for the IMICTRON are described. A model of a new information processing system defined as Time Interval Modulation Coding, TIMIC, is given. The IMICTRON is satisfied with TIMIC operations. An IMICTRON modulated feedback control system is also proposed, and a control system containing time invariant linear differential systems is considered. The problem of input noise for the IMICTRON modulator was studied, and a method of evaluating the input noise immunity presented by the modulator is discussed. A dynamic visual pattern recognition network of the IMICTRON is also discussed. Some of the properties of the IMICTRON as an artificial neuron are described, and the IMICTRON is used to simulate a certain sensory receptor. Other miscellaneous applications of the IMICTRON are also presented. L.S.

N67-34191# National Bureau of Standards, Boulder, Colo. Radio Standards Lab.

A STANDARD FOR ACCURATE PHASE-ANGLE MEASUREMENTS AT AUDIO FREQUENCIES

Winston W. Scott, Jr. 14 Oct. 1966 34 p refs

(NBS-TN-347) GPO: $0.25

A method is described for the measurement of phase angles from 0° to 360° (except for a band ±10° about the 180° point) with an uncertainty at audio frequencies of ±0.05° to ±0.01°, depending on the phase-angle. The method utilizes readily available equipment which may be assembled and connected to serve as a standard. The principal advantage of this standard is in its potentially broad frequency-response; namely, 10 Hz to 10 kHz or higher. It makes use of inductive voltage dividers and thermal voltage converters to compare voltage magnitudes, which are related to phase-angle by the law of cosines. The thermal voltage converters are compared with each other before each phase-angle measurement. A model has been built which shows good measurement precision, but it has not been thoroughly tested or studied at many frequencies and phase-angles for sources of error. Author

N67-34400# California Univ., Berkeley. Lawrence Radiation Lab.

ANALYSIS AND DESIGN OF A PULSE-WIDTH-MODULATED CONTROL SYSTEM

Craig Allen Denison (M.S. Thesis) Mar. 1967 83 p refs

(Contract W-7405-ENG-48)

(UCRL-17011) CFSTI: HC $3.00/MF $0.65

The design of a pulse-width-modulated (PWM) regulator-type controller for a servomotor-type of plant is described. The objectives are: to derive the equations which describe the time-optimal strategy for the specific case of the servomotor plant, to discuss PWM control using linear feedback and what are the apparent limitations of the present design techniques, to define a set of linear feedback coefficients in a manner so that the system's trajectory can be very close to the time-optimal trajectory, and to compare the performance of the time-optimal and linear PWM controllers. The approach to the design problem is principally one of utilizing the time-optimal control strategy to suggest a design for a simple (but suboptimal) linear feedback, PWM controlled system. Considerable experimental results from computer simulations are presented. These results indicate how the relative performance of the optimal and linear controllers depends on the sample period size, the target size, and several different initial conditions. Author (NSA)

N67-34417 National Aerospace Lab., Tokyo (Japan).

MEASUREMENT OF SMALL ROTATING ANGLE BY THE FREQUENCY MODULATION TECHNIQUE

Masao Ootuki, Takao Suzuki, and Shigeharu Enkyo 1967 12 p refs In JAPANESE; ENGLISH summary

(NAL-TR-127)

In order to reduce the null voltages and the reaction torques that are inherent in microsyn, the method by which the rotor displacement angle of microsyn is directly converted into a change in frequency of oscillation was studied. In this method, a microsyn (an electromagnetic variable reluctance device) is applied as a variable self-inductance transducer in a Franklin oscillator circuit. The midpoint of rotation corresponds to the center frequency of oscillation. The direction of rotation is distinguished by the increase or decrease in frequency. Some conclusions from this experiment are as follows: (a) ±280 c/s frequency deviation is obtained

corresponding to an input angle of ±2.8 degrees with 1% or less error in linearity; (b) the resolution of the angle is less than 1/100 degrees; (c) the reaction torque is estimated as extremely low (approximately 10^{-5} dyn-cm); and (d) the variations of center frequency by changes in temperature and of power supply voltage are very small. Author

N67-34462* Arizona Univ., Tucson. Nuclear Engineering Dept.
RESEARCH IN AND APPLICATION OF MODERN AUTOMATIC CONTROL THEORY TO NUCLEAR ROCKET DYNAMICS AND CONTROL Semiannual Progress Report
James L. Melsa, Rudolf J. Fillmeier, William W. Bottorff, and William J. Steinway Jul. 1967 103 p
(Grant NsG-490)
(NASA-CR-87475) CSCL 09C

The subject of system identification is treated and two methods of solving the problem are presented. Systematic search procedures are discussed in detail and some preliminary results are shown which illustrate the difficulties in this approach. The use of quasilinearization is mentioned. The area of data reconstruction is examined with emphasis on the use of non-resetting integrators. Some new results are given which show that non-resetting data reconstruction devices may be superior to the classical configuration. General methods for the design and optimization of data reconstruction devices are shown. The invariant imbedding technique is used to develop two methods of suboptimal closed loop control. The first approach is based on treating the problem as a varying initial condition problem, while the second method treats the problem as a varying end point problem. Approximate solutions for both problems are discussed. R.N.A.

N67-34554 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REALIZATION OF A BOOLEAN FUNCTION OF N VARIABLES BY MEANS OF A NETWORK OF THRESHOLD ELEMENTS WITH N INPUTS
Ye. A. Butakov *In its* Probl. of Inform. Transmission 31 Jan. 1967 p 23–41 refs (See E67-34552 20-07)

A method of synthesizing a multielement circuit constructed from threshold elements and realizing an arbitrary Boolean function of n variables is set forth. The method is semiintuitive and makes use of the properties of visual perception of information. In this article a method of constructing a single-row network from threshold elements based on the possibility of representing a Boolean function in the form of a disjunction of threshold functions is considered. The method makes use of the advantages offered by the visual perception of the matrix representation of a Boolean function and is approximate in the sense that it does not guarantee the minimum of the number of threshold elements in the network. The practical use of the method, however, showed that for $n < 10$ it yields the minimum or almost the minimum value of the number of threshold elements. The simplicity of the method and the fact that it can be applied immediately in engineering practice are great advantages. Author

N67-34555 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOME PROPERTIES OF SYMMETRIC FUNCTIONS OF TRIADIC LOGIC
B. L. Osiyevich *In its* Probl. of Inform. Transmission 31 Jan. 1967 p 42–55 refs (See N67-34552 20-07)

Some properties of symmetric functions of triadic logic are set forth, and a class of so-called step functions is considered. Methods of discovering the symmetry and the step property of the functions are proposed, as well as methods of synthesizing circuits realizing the symmetric and step-like functions in a majority basis. The appearance of a number of new elements such as the parametron, the twin, etc, which can be used under tristable conditions, poses the problem of working out methods by which circuits consisting of these elements could be synthesized. Thus, on the basis of the parametron, a tristable majority element with three inputs and one output may be designed. Author

N67-34556 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE BEHAVIOR OF AUTOMATA IN PERIODIC RANDOM MEDIA AND THE PROBLEM OF SYNCHRONIZATION IN THE PRESENCE OF INTERFERENCE
V. I. Varshavskiy, M. V. Meleshina, and M. L. Tsetlin *In its* Probl. of Inform. Transmission 31 Jan. 1967 p 56–69 refs (See N67-34552 20-07)

The behavior of automata in random media whose probability characteristics are switched over periodically is studied. Designs of automata minimizing the mathematical expectation of penalty in the case of a given period of switching and in the case where the period of switching is determined by the machine are described. The possibility of describing the process of synchronization is, e.g., considered in a system of telemetric information transmission with time division of the channels in the presence of noise in terms of the behavior in periodic random media. The possibility of using the principles of constructing the automata considered in the paper for the construction of the corresponding synchronizers is shown. The behavior of automata in random media whose probability characteristics were switched over by a simple Markov chain has been studied. The existence of an optimum memory capacity for a machine with linear tactics has been detected. Author

N67-34647# Royal Aircraft Establishment, Farnborough (England).
A MATRIX METHOD FOR OBTAINING THE TRANSIENT RESPONSE OF A FILTER
J. M. Freeland Dec. 1966 13 p refs
(RAE-TR-66372; AD-653690) CFSTI: HC $3.00/MF $0.65

A matrix method is described for obtaining the transient response of a passive electrical filter. The transfer function is first derived in partial fraction form, and then the appropriate inverse Laplace transform can be determined directly. Author (TAB)

N67-34718# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF ORTHOGONAL FILTERS FOR OPTIMIZATION AND INVESTIGATION OF STATISTICAL PROPERTIES OF ERRORS OF SELF-ADJUSTING SYSTEMS [PRIMENENIYE ORTOGONAL'NYKH FIL'TROV DLYA OPTIMIZATSII I ISSLEDOVANIYA STATISTICHESKIKH SVOYSTV OSHIBOK SAMONASTRAIVAYUSHCHIKHYSA SISTEM]
G. A. Sergeyev and A. F. Romanenko 28 Mar. 1967 9 p refs Transl. into ENGLISH from Analit. Samonastraivayushchiyesya Sistemy Avtomatiz. Upra (Moscow), 1965 p 221–232
(FTD-MT-66-67; TT-67-62130; AD-653560) CFSTI: HC $3.00/MF $0.65

The authors present an equation that can be used for the definition of a simple and comparatively efficient smoothing out operator S sub T, convenient for the processing of nonstationary processes. TAB

N67-34745*# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
ESTIMATION USING SAMPLED-DATA CONTAINING SEQUENTIALLY CORRELATED NOISE
A. E. Bryson, Jr. and L. J. Henrikson Jun. 1967 23 p refs
(Grant NGR-22-007-068; Contract Nonr-1866(16))
(NASA-CR-87502; TR-533) CFSTI: HC $3.00/MF $0.65 CSCL 09C

Improved filtering, prediction, and smoothing procedures are presented for multi-stage linear dynamic systems when the measured quantities are linear combinations of the state variables with additive sequentially correlated noise. The augmented state procedure suggested by Kalman may lead to ill-conditioned computations in constructing the data processing filter. The design procedure described here eliminates these ill-conditioned computations and reduces the dimension of the filter required. The results include explicit relations for prediction, filtering, and smoothing procedures and the associated covariance matrices. Author

N67-34787# California Univ., Berkeley. Lawrence Radiation Lab.
BROADBAND MODULATION OF HIGH-Q RESONATORS AT HIGH POWER LEVELS
Kenneth R. Mac Kenzie 23 Feb. 1967 45 p
(Contract W-7405-ENG-48)
(UCRL-17372) CFSTI: HC $3.00/MF $0.65

Electronic broadband frequency modulation of a high-Q resonator operating at high voltages is considered. The simple over-coupled transformer is shown to be the most practical way to couple the final amplifier tubes to the resonator. Capacities other than the resonator capacity and the inherent tube capacity should be minimized. Transmission lines should be high-impedance and as short as possible. The maximum frequency range is shown to be governed by $V_1\Delta\omega = 1.4\,\gamma g$, where V_1 is the resonator voltage, $\gamma = V_1/V_2$ (where V_2 is the tube rf voltage), and $g = I_b$ is the tube filament emission and C_2 is the tube capacity. This relation reduces to $V_2\Delta\omega = 1.4\,g$, showing that $\Delta\omega$ is limited only by tube parameters and not by resonator capacity or voltage. The minimum average power using a programmed dc plate voltage is shown to be $0.2\,V_1^2\,C_1\Delta\omega$ (where C_1 is the resonator capacity). Modulation rates, higher-order modes, transmission-line corrections, and other coupling schemes are discussed. Author (NSA)

N67-34801 Royal Aircraft Establishment, Farnborough (England).
MATRIX METHODS FOR THE ANALYTIC DETERMINATION OF THE OUTPUT AUTOCORRELATION FUNCTIONS OF LINEAR SYSTEMS FOR STATIONARY RANDOM INPUTS. PART I: SYSTEM AUTOCORRELATION FUNCTION METHOD
E. Huntley Dec. 1966 58 p refs
(RAE-TR-66387)

A method is presented which, by means of matrix operations and tabulated results, appreciably simplifies the determination of the autocorrelation functions of output responses of linear systems when they are subjected to random inputs with zero mean values. Starting with the determination of the system unit impulse response, the system autocorrelation function is then derived and a convolution integral theorem for autocorrelation functions is used to give algebraic expressions for the output autocorrelation functions and output mean square values. Standard results for a range of input autocorrelation functions are tabulated. As an illustration of the method, the second-order system is studied in detail and simple closed form expressions are derived for displacement, velocity and acclaration responses when the input autocorrelation functions are of the types frequently encountered in studies of aircraft response to atmospheric turbulence. Author

N67-34815# Joint Publications Research Service, Washington, D. C.
RESEARCH IN CYBERNETICS AND THEORY CONTROL
4 Aug. 1967 14 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 174, no. 1, 1967 p 45–49
(JPRS-42093; TT-67-32723)

CONTENTS:

1. DETERMINING THE CONTINUOUS OPERATING COMPONENT OF QUASI-CONTINUOUS PULSE SYSTEMS A. A. Bulgakov p 1–4 refs (See N67-34816 20-10)

2. SYNTHESIS OF VARIATION ALGORITHMS OF ADJUSTABLE COEFFICIENTS IN MODEL REFERENCE ADAPTIVE SYSTEMS S. D. Zemlyakov and V. Yu. Rutkovskiy p 5–9 refs (See N67-34817 20-10)

N67-34816 Joint Publications Research Service, Washington, D. C.
DETERMINING THE CONTINUOUS OPERATING COMPONENT OF QUASI-CONTINUOUS PULSE SYSTEMS
A. A. Bulgakov *In its* Res. in Cybernetics and Theory Control 4 Aug. 1967 p 1–4 refs (See N67-34815 20-10)

If a continuous linear circuit is connected beyond the pulse element, which has filtering properties, the useful action at its output, due to the principle of superposition, is determined directly from the characteristics of the pulse element, while the distortion is evaluated by the pulsations of the stationary operating mode in the worst area. As a result, it is possible to analyze quasi-inertial pulse systems using ordinary continuous circuit apparatus. The class of pulse systems which can be analyzed is considerably expanded and their physical essence can be determined. R.N.A.

N67-34817 Joint Publications Research Service, Washington, D. C.
SYNTHESIS OF VARIATION ALGORITHMS OF ADJUSTABLE COEFFICIENTS IN MODEL REFERENCE ADAPTIVE SYSTEMS
S. D. Yemlyakov and V. Yu. Rutkovskiy *In its* Res. in Cybernetics and Theory Control 4 Aug. 1967 p 5–9 refs (See N67-34815 20-10)

A numerical analysis is made of the motion stability of a nonsearching adaptive control system with model reference. As a model reference, a filter described by a differential equation is used. Variation algorithms of adjustable coefficients in the system are synthesized. R.N.A.

N67-34936*# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
A NEIGHBORING OPTIMUM FEEDBACK CONTROL SCHEME BASED ON ESTIMATED TIME-TO-GO WITH APPLICATION TO RE-ENTRY FLIGHT PATHS
Jason L. Speyer and Arthur E. Bryson, Jr. Jun. 1967 51 p refs
(Grant NGR-22-007-068; Nonr-1866(16))
(NASA-CR-87501; TR-527) CFSTI: HC $3.00/MF $0.65 CSCL 09C

A modification of the perturbation feedback control scheme is presented that greatly increases its capability to handle disturbances in cases where the final time is not specified. The modified control scheme uses a set of precalculated gains which allows in-flight estimation of the change in the final time due to perturbations from a nominal path. The time-to-go, determined from the predicted change in final time, is used to enter tables of precalculated feedback control gains. This modified guidance scheme is applied to a re-entry glider entering the atmosphere of the earth at supercircular velocities. Beginning at the bottom of the pull-up maneuver (nominal altitude 188,000 ft., nominal velocity 33,000 ft./sec.$^{-1}$) the glider is guided to a terminal altitude of 220,000 ft. and zero flight path angle with maximum terminal velocity. For initial altitudes between 167,000 and 216,000 ft. the terminal error in altitude is less than two feet; for initial velocities between 23,000 ft./sec. and 43,000 ft./sec. the terminal altitude error is less than 13 ft. The terminal velocity is very close to optimal for these initial conditions. Author

N67-34946 Technische Hochschule Munchen (West Germany). Der Fakultaet fuer Maschinenwesen und Elektrotechnik.
ANALYTICAL APPROXIMATION OF EXPERIMENTALLY DETERMINED TRANSITION FUNCTION AND FREQUENCY RESPONSE CURVES TO THE CALCULATION OF A SUBSTITUTE STRUCTURE AND THE SIMPLE CARRYING OUT OF THE LAPLACE TRANSFORMATION [ANALYTISCHE NAEHERUNG EXPERIMENTELL BESTIMMTER UBERGANGSFUNKTIONEN UND FREQUENYGAENGE ZUR BERECHNUNG EINER ERSTZSTRUKTUR UND ZUR EINFACHEN DURCHFUHRUNG DER LAPLACE-TRANSFORMATION]
Udo Renner (Ph.D. Thesis) 1967 17 p refs In GERMAN

A substitute structure which is described solely by poles and zero points is found for determining the true structure of a control system. The poles are fixed by sensible criteria prior to the calculation, and the zero points are fitted to the known existing measuring curve. The mathematical effort is kept to a minimum by introduction of a suitable set of norms. The system is a substitute for the black box control system and reacts also to all periodic and aperiodic stimuli. Transl. by K.W.

N67-35063# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
ELECTRONIC AUTOMATION OF VISCOSITY MEASUREMENTS [AUTOMATIZZAZIONE ELETTRONICA PER MISURE DI VISCOSITA]
C. Felici and C. Ranghiasci 4 Mar. 1967 18 p In ITALIAN; ENGLISH summary
(ISS-67/7)

This report describes an electronic circuit which has been designed to measure the viscosity of liquids automatically. Corresponding to each reference line of an Ubbelohde capillary viscosimeter there are two small lamps which illuminate, across the liquid column to be investigated, two light-sensitive elements. The passage of the air-liquide meniscus causes a variation in the intensity of the light falling on the detectors and consequently generates an electric signal. The signal from the upper element activates an electronic clock whilst that from the lower one stops it. The reading of the flow time so determined is recorded on paper and punched on tape. Author

N67-35281 Joint Publications Research Service, Washington, D. C.
TECHNICAL CYBERNETICS, NO. 2, 1967
11 Jul. 1967 279 p refs Transl. into ENGLISH of Tekhn. Kibernetika (Moscow), no. 2, 1967 p 1–184
(JPRS-41786; TT-67-32418) CFSTI: $3.00

Articles on control problems and operations research, queueing systems and problems in reliability, finite automata, information processing, and automatic control are presented. For individual titles see N67-35282–N67-35302.

N67-35282 Joint Publications Research Service, Washington, D. C.
THE METHOD OF SEQUENTIAL OPTIMIZATION IN CONTROL PROBLEMS
V. M. Ponomarev *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 1–8 refs (See N67-35281 20-10)

An investigation of the problem of optimization of a linear control system including information and command units is presented, and found under the influence of random disturbances in the presence of restrictions in the form of inequalities imposed on the phase coordinates and control effects. The problem of optimization of control in a closed system reduces to the problem of nonlinear programming. The method of sequential approximations is proposed, which may be used for optimization of systems both with constant and with variable parameters. Author

N67-35283 Joint Publications Research Service, Washington, D. C.
CONSIDERATION OF INFORMATION COSTS IN THE THEORY OF INFORMATION VALUE
B. A. Grishanin *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 9–20 refs (See N67-35281 20-10)

In place of the ordinary penalty function used in decision theory and in the theory of information value, the loss function of a more general type is introduced which takes into consideration the cost of information. As the criterion of the optimum here the condition of minimalness of the average losses of the indicated type is assumed. The solution of the extremal problem corresponding to this optimal criterion is presented. Author

N67-35284 Joint Publications Research Service, Washington, D. C.
THE USE OF A PRIORI INFORMATION IN THE LEAST SQUARES METHOD
Yu. A. Kochetkov *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 21–40 refs (See N67-35281 20-10)

The widely known method of least squares is generalized to the case of evaluating nonlinear functions of unknown parameters. The linear combination of these parameters together with additive noise is the result of measurements. In the case of normally distributed parameters and errors in measurements for polynomials of unknown parameters specific expressions of optimal estimates are obtained. The formulas obtained for the error dispersion are significantly simplified. The nonbias of the optimal estimates is proved. The simplest multidimensional problem is investigated. Author

N67-35286 Joint Publications Research Service, Washington, D. C.
EVALUATING THE EFFICIENCY OF REPAIRABLE CONTROL SYSTEMS
K. S. Yherbin and A. A. Pervozvanskiy *In its* Tech. Cybernetics No. 2, 1967 11 Jul. 1967 p 53–61 refs (See N67-35281 20-10)

An investigation of evaluating the efficiency of automatic control systems by comparing the given system with the optimal and the ideally functioning system is presented. As the efficiency index the mathematical expectancy of the criterial functional of the automatic control system is used under the conditions of incomplete reliability. Under the simplest assumptions expressions are obtained for the efficiency index of one class of self-adjusting systems in the case of failures of the self-adjusting network of the disconnecting type. Author

N67-35288 Joint Publications Research Service, Washington, D. C.
CALCULATION OF THE LOWER FIDUCIAL LIMIT FOR THE PROBABILITY OF TROUBLE-FREE OPERATION OF COMPLEX SYSTEMS, I
Yu. K. Belyayev, T. N. Dugina, and Ye. V. Chepurin *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 75–86 refs (See N67-35281 20-10)

A description of the algorithm is given for calculation of the lower fiducial bound of the probability of trouble-free operation of a system with respect to results from testing its components. The algorithm is intended for application in the situation of insufficient data on the reliability of the elements where the numbers of breakdowns recorded during tests run on the elements are small. The class of systems for which the proposed algorithm is applicable includes the systems of the series-parallel-series type with a loaded reserve. The statement of the problem, a short description of the concept on which construction of the algorithm is based are given, and also the results of numerical calculations obtained using a computer are presented. Author

N67-35289 Joint Publications Research Service, Washington, D. C.

THE AVERAGE TIME OF TROUBLE-FREE OPERATION OF A COMPLEX SYSTEM TAKING INTO ACCOUNT THE "IMPORTANCE" OF ITS ELEMENTS AND PLANNED PREVENTIVE MAINTENANCE

Sh. L. Babiashvili, O. M. Namicheyshvili and A. P. Khuskivadze *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 87–94 refs (See N67-35281 20-10)

Calculations are presented for the average time of trouble-free operation of a complex system taking into account planned preventive maintenance and functional importance of its elements with an exponential law of their being trouble-free. Under the assumption that the average time of trouble-free operation of the system is given and conditions are ensured in it which are required for maximum efficiency, the problem of determination of average time of trouble-free operation of individual elements is solved. Author

N67-35290 Joint Publications Research Service, Washington, D. C.

THE DETERMINATION OF THE PROBABILITY THAT A ONE-DIMENSIONAL MARKOV PROCESS WILL NOT REACH THE FIXED BOUNDARIES

V. S. Yaritskiy *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 95–104 refs (See N67-35281 20-10)

An investigation is conducted of the problem of determining the probability that a random function u(t), with the correlation function $K_u(\tau) = \sigma^2 \exp\{-\alpha |\tau|\}$, will not go beyond a region in the time T, the boundaries of which are given and may be arbitrarily located with respect to the mathematical expectancy of the function u(t). The probability that in the time T the function u(t) will be in a region with a one-sided restriction is also defined. Author

N67-35294 Joint Publications Research Service, Washington, D. C.

AN ECONOMICAL AUTOMATON ENCODING PROCEDURE

Ye. N. Vavilov and D. B. Shishkov *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 150–164 refs (See N67-35281 20-10)

An algorithm is proposed for economical encoding of automata based on the analysis of a system of excitation functions of elementary automata represented in some canonical form. Examples are presented which illustrate the advantages of the proposed method over an encoding method cited. Author

N67-35295 Joint Publications Research Service, Washington, D. C.

POLYNOMIAL REPRESENTATIONS IN A CLASS OF THREE-VALUED LOGICS

Zh. Toshich *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 165–171 refs (See N67-35281 20-10)

The polynomial representations of three-valued functions are investigated to the base consisting of two-place operations of the sum and product with respect to modulus three, constants, and one one-phase operation. A class of 18 bases satisfying these conditions is studied. In each base the derivatives are defined and the possibility of expansion in a series is demonstrated. Author

N67-35296 Joint Publications Research Service, Washington, D. C.

EVALUATION OF A NONLINEAR FUNCTION WHEN OBSERVING A SIGNAL CONTAINING NOISE

G. I. Bel'chanskiy *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 172–188 refs (See N67-35281 20-10)

An algorithm is obtained for calculating the statistical value of a nonlinear function with respect to the results from processing the observed signal, the values of the coordinate functions of which are defined by the state of a dynamic system described by ordinary differential equations. The presence of a priori information about the parameters of the evaluated function is assumed and the law of distribution of the noise is assumed to be normal. Cases of discrete and continuous processing are investigated. Author

N67-35299 Joint Publications Research Service, Washington, D. C.

ANALYSIS OF THE STEP AUTOMATIC SEARCH SYSTEM

G. A. Medvedev and A. I. Ruban *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 214–230 refs (See N67-35281 20-10)

Formulas are obtained for definition of finite probabilities (the probabilities of states) of a two-connected Markov chain, the average time of transition from one state (conditional or unconditional) to another, and also the dispersion of this transition time. The results are used for the analysis of problems in behavior and speed of step automatic search systems in which the realization of the operating step is accomplished on the basis of observations made not only after the nearest preceding step but also before it. Author

N67-35300 Joint Publications Research Service, Washington, D. C.

THE ORTHOGONAL METHOD FOR INVESTIGATING NONLINEAR AUTOMATIC CONTROL SYSTEMS UNDER RANDOM EFFECTS

K. A. Pupkov and G. G. Sebryakov *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 231–247 refs (See N67-35281 20-10)

A method is proposed for investigating nonlinear automatic control systems under random effects based on expansion of nonlinear functionals in a series with respect to the Hermite polynomials. In this work, the expansion of the n-dimensional normal probability density with respect to the orthogonal Hermite polynomials is obtained. On the basis of these results, a procedure is developed for definition of the times of the random process in open and closed nonlinear systems. Author

N67-35301 Joint Publications Research Service, Washington, D. C.

ITERATION METHOD FOR FINDING THE OPTIMAL NONLINEAR FILTER FOR A STATIONARY RANDOM PROCESS

A. S. Kholevo *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 248–256 refs (See N67-35281 20-10)

An iteration method is proposed for the construction of an optimal nonlinear filter and a basis is presented for it. The method requires integration at each step only. Author

N67-35302 Joint Publications Research Service, Washington, D. C.

A METHOD OF INVESTIGATING NONLINEAR AUTOMATIC CONTROL SYSTEMS

Nguyen Thuc Loan *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 257–266 refs (See N67-35281 20-10)

Formulas are presented for calculating transient processes in nonlinear systems. A method is proposed for determination of the parameters of nonlinear automatic control systems with respect to the given transient process. The method is applicable for calculating systems with arbitrary initial conditions and any form of the input effect. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N67-34014# Tokyo Univ. (Japan). Inst. of Industrial Science.
ON SHIP EXPERIMENT TANK WITH WIND TUNNEL
Shin Tamiya Mar. 1967 32 p refs In JAPANESE; ENGLISH summary *Its* Rept. of the Inst. of Ind. Sci., Vol. 17, No. 6
CFSTI: HC $3.00/MF $0.65

A ship experiment tank made of mild steel in conjunction with a wind tunnel was constructed for the purpose of studying the characteristics of wind and of waves generated by a wave generating device as part of the apparatus. Interactions were found to exist between wind and waves generated by the wave maker. The wave height is diminished somewhat with increasing velocity of wind, but the amount of reduction is not large enough to obstruct the experiment taking place. However the wind velocity fluctuates periodically in accordance with wave form, and its influence results in a little increase of mean wind pressure and synchronous pressure variation. Some experiments carried out in the tank are briefly described. L.S.

N67-34041# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany).
LOW-POWER-ARC-HEATERS FOR LOW-DENSITY-HYPER-VELOCITY-TUNNELS [LICHTBOGEN-BRENNKAMMERN NIEDRIGER LEISTUNG FUR HYPERGESCHWINDIGKEITS-VAKUUM-WINDKANALE]
K. Stursberg Jun. 1967 43 p refs In GERMAN; ENGLISH summary
(DLR-Mitt.-67-10; DVL-653)

By means of a simple layout the basic constructional features of arc heaters and their operating modes are described. A few remarks on the effect of aerodynamic and magnetic forces on the anode attachment region and on the contraction of the discharge by a nozzle are included. Furthermore, the working fluids, power supply cooling, and operating conditions are discussed. The considerations refer to arc heaters for wind tunnels and not to thermoelectric propulsion units. Author

N67-34067# Naval Ordnance Lab., White Oak, Md.
THE U.S. NAVAL ORDNANCE LABORATORY HYPERSONIC TUNNEL
F. Geineder, M. I. Schlesinger, G. Baum, and R. Cornett 12 Apr. 1967 66 p refs
(NOLTR-67-27; Aerodynamics Res. Rept.-284; AD-653853) CFSTI: HC $3.00/MF $0.65

The report describes the aerodynamic capability and physical plant installation of the U. S. Naval Ordnance Laboratory's Hypersonic Tunnel. The tunnel is a high pressure blowdown facility, using air as the working gas, operating at Mach numbers 5, 6, 7, 8, 9 and 10 with test section Reynolds Number from 3000 thousand to 50 million per foot. The stagnation pressure may be varied between 5 and 150 atmospheres with stagnation temperatures sufficient to prevent equilibrium condensation in the test section. Author (TAB)

N67-34180# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
PROPERTIES OF A WIDE GAP SPARK CHAMBER IN MEASUREMENTS OF DIRECTION
V. Manno and R. Visentin 21 Apr. 1967 12 p refs *Its* Note Interna No. 364
(LNF-67/33) CFSTI: HC $3.00/MF $0.65

Results obtained in measurements of the shift (distance between the track in the wide gap spark chamber and the path of the ionizing particle), and of the angular efficiency in different working conditions, are presented. A schematic diagram of the chamber system is depicted. The results agree with similar measurements of some cited authors, and the slight discrepancies with one author's values are explained in terms of the different values used for Townsend's first coefficient in helium or in neon. L.S.

N67-34240# Brookhaven National Lab., Upton, N. Y.
14-FOOT BUBBLE CHAMBER RESEARCH AND DEVELOPMENT PROGRAM: OVERALL PLAN AND OPTICS DETAILS
R. I. Louttit [1967] 18 p Presented at the Intern. Colloq. on Bubble Chambers, Heidelberg, Apr. 1967
(Contract AT(30-2)-GEN-16)
(BNL-11313; CONF-670416-1) CFSTI: HC $3.00

The construction of a one-half linear scale model of the proposed BNL 14-foot bubble chamber is discussed. Topics discussed are the optical system, use of Scotchlite, and neon–hydrogen mixtures. NSA

N67-34293# Naval Civil Engineering Lab., Port Hueneme, Calif.
COMPACTED-SNOW RUNWAYS IN ANTARCTICA—LIMITATIONS OF CONTAMINATED SNOW
G. E. Sherwood and E. H. Moser, Jr. Jun. 1967 24 p refs
(R-533; AD-654140) CFSTI: HC $3.00/MF $0.65

Techniques and equipment have been developed to utilize clean, undisturbed snow as a building material for emergency and temporary roads, runways, and skiways in polar regions. However, these routes are often needed in areas where the snow is contaminated. During Deep Freeze 65, a compacted-snow runway was constructed in an area of contaminated snow near McMurdo, Antarctica. The area had been contaminated by oil spillage, soot, and debris from previous operations. Physical property tests were conducted on the compacted snow near the end of Deep Freeze 65 and during Deep Freeze 66. It was concluded that contaminated snow can be processed to produce load-carrying material capable of supporting C-130 aircraft and other heavy loads at temperatures below 20F; however, because of the extra work involved to clear and process such snow, its marginal load-carrying capabilities at temperatures above 20F, and the possibility of low-strength areas, its use is not recommended where clean snow is available. New processing techniques resulted in improved quality control of compacted snow, and it was recommended that effort be continued to improve processing techniques. Author (TAB)

N67-34381# Princeton Univ., N. J. Plasma Physics Lab.
THE LIVERMORE l=2 STELLARATOR
George V. Sheffield and John L. Johnson Feb. 1967 12 p refs
(Contract AT(30-1)-1238; Grant NSF GP-579)
(MATT-530) CFSTI: HC $3.00/MF $0.65

A high-shear l=2 stellarator with a 9" major radius, 3" minor radius, and five field periods is being constructed at Livermore to study the confinement of Cs, K, or Li. Some of the magnetic properties of this stellarator are described. NSA

N67-34387# California Univ., Berkeley. Lawrence Radiation Lab.
EXPANSION OF THE BEVATRON EXTERNAL PROTON BEAM EXPERIMENTAL FACILITIES
Kenow H. Lou 17 Feb. 1967 9 p refs Presented at the Natl. Particle Accelerator Conf., Washington, D. C., 1–3 Mar. 1967
(Contract W-7405-ENG-48)
(UCRL-17276; CONF-670307-42) CFSTI: HC $3.00/MF $0.65

The External Proton Beam Channel has seen intensive utilization since its installation at the Bevatron. A program now in progress will further enhance its versatility by increasing target areas, beam intensities, experimental floor area, shielding and utilities. The physical facilities, among which is a truly unique overhead crane design is described. The proton beam operation and characteristics are discussed in the Bevatron Experimenters Handbook. Author (NSA)

N67-34388# California Univ., Berkeley. Lawrence Radiation Lab.
A SMALL HELIUM-3 CYCLOTRON
R. M. Main, M. R. Curtis, R. Grazier, P. B. Kennedy, B. H. Smith et al Mar. 1967 12 p refs Presented at the Natl. Particle Accelerator Conf., Washington, D. C., 1–3 Mar. 1967
(Contract W-7405-ENG-48)
(UCRL-17274; CONF-670307-37) CFSTI: HC $3.00/MF $0.65

A 27-inch AVF cyclotron of fourfold symmetry designed specifically for use in helium-3 activation analysis is now in operation at the Lawrence Radiation Laboratory in Berkeley. The fixed energy and modest beam quality requirements have resulted in an instrument of minimum size, weight, power consumption, and fabrication costs. New techniques were developed to construct edge-cooled tape-wound magnet coils which are housed inside the vacuum chamber. Other unusual design features include: unit construction dee liners hydraulically pressed to the pole tip contours; two 55° dees-in-valleys operating in push–pull; a removable top yoke assembly which allows complete access to the pole area; a narrow gap with an average spacing of 1.5 inches making possible maximum utilization of the pole diameter for stable orbits. In conjunction with the tape coils, the use of this small gap also results in a magnet of very high efficiency. The cyclotron operates with an average field of 16.6 kG and a grounded-grid triode provides 40 kV dee-to-ground (150 keV/turn). Power is supplied by 220 V, 3-phase service. The magnet requires 17 kW, the rf system uses 17 kW, and the remaining instruments, pumps, and controls use an additional 6 kW. The complete system, including vacuum pumps and power supplies, weighs 10.7 tons and occupies a floor space of 37×64 inches. Author (NSA)

N67-34395# California Univ., Berkeley. Lawrence Radiation Lab.
A PRESTRESSED-CORE HOLLOW-STRAP-COIL TEST MAGNET FOR THE OMNITRON
D. T. Scalise and E. H. Hoyer 23 Feb. 1967 11 p refs Presented at the Natl. Particle Accelerator Conf., Washington, D. C., 1–3 Mar. 1967
(Contract W-7405-ENG-48)
(UCRL-17268; CONF-670307-45) CFSTI: HC $3.00/MF $0.65

Design, fabrication, and preliminary testing of a test prototype gradient magnet for the Omnitron incorporating several novel design features is reported. The laminated magnet core achieves structural integrity with prestressed tension rods which hold the 0.014-in.-thick M-19 steel laminations with an average interlamination pressure of 200 psi. Some advantages of such a system are: elimination of strong backs for support of individual laminations, a higher steel packing factor than for glued laminations, and easy disassembly of the magnet to make changes during test and development. Simplicity in coil design is achieved using a continuous 9/32- by 3-in. hollow-strap aluminum conductor wound in a single layer. The high section modulus of the strap eliminates the need for coil clamps at the ends of the magnet. Furthermore, this coil design avoids multiple cooling connections between pancakes and saddle-shaped coil ends, because notches can be machined into the coils after they are wound. Author (NSA)

N67-34398# California Univ., Berkeley. Lawrence Radiation Lab.
CERAMIC VACUUM CHAMBER FOR A FAST-CYCLING PROTON SYNCHROTRON
Peter T. Cloe and H. Paul Hernandez 1 Feb. 1967 14 p refs Presented at the Natl. Particle Accelerator Conf., Washington, D. C., 1–3 Mar. 1967
(Contract W-7405-ENG-48)
(UCRL-17254; CONF-670307-38) CFSTI: HC $3.00/MF $0.65

Alumina ceramic vacuum chambers are proposed in the area of the magnets for the 8-GeV injector synchrotron of the 200-GeV accelerator. The chambers cannot be made in one piece, and the only acceptable joint involves metal, which has a perturbing effect on the magnetic field. For this reason it was proposed that the longest possible ceramic be used to keep the joints to a minimum, but long ceramics require wider tolerances, and this becomes costly in magnet gap. Sample ceramics produced by industry were examined, and from the results the overall cost of ceramics and magnet gap were related to ceramic length. Installing and locating the chambers in the magnet gap is difficult due to the restrictions of shape and size of the gap. Author (NSA)

N67-34447# Commissariat a l'Energie Atomique, Grenoble (France). Section des Accelerateurs.
AUTOMATIC REENGAGEMENT OF PUMPING AND NEUTRON SAFETY OF THE GNP-1 ACCELERATOR [REENCLENCHEMENT AUTOMATIQUE DU POMPAGE ET SECURITE NEUTRONS DE L'ACCELERATEUR GNP 1]
D. Giloppe and M. Pontonnier Nov. 1965 15 p In FRENCH
(NT-65-18; NP-16619)

Two automatic devices added to the GNP-1 accelerator in order to start the pump in operation again after a voltage loss and to avoid a sudden neutron burst are described. The circuit for the partial automation of the pumping system is given in detail. NSA

N67-34483# Ludwig-Maximillians-Universitat, Munich (West Germany).
ON THE 125th ANNIVERSARY OF THE OBSERVATORIES MUENCHEN–MAISACH–FUERSTENFELDBRUCK [ZUM 125 JAEHRIGEN BESTEHEN DER OBSERVATORIEN MUENCHEN–MAISACH–FUERSTENFELDBRUCK]
1966 90 p In GERMAN

A yearbook is presented on the 125th anniversary of the Muenchen–Maisach–Fuerstenfeldbruck Observatories. Photographs and schematics complete the technical details and recorded data provided on earth magnetism and other astronomical and geophysical research topics. R.U.

N67-34499# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
A 15 kV TRIGGER-GENERATOR WITH SPARK GAP [15 kV TRIGGERGERAET MIT FUNKENSTRECKE]
R. C. Kunze and E. v. Mark Jun. 1967 13 p In GERMAN; ENGLISH summary
(IPP-4/43) CFSTI: HC $3.00/MF $0.65

In the field of power discharges, for many applications (e.g. triggering of spark gaps or Kerr cells), fast rising, low jitter high voltage pulses are needed. A pulse generator is described which satisfies the above requirements, is unaffected by voltage transients, and has a long life. Author

N67-34541# Royal Aircraft Establishment, Farnborough (England).
ADDITIONAL FACILITIES AVAILABLE WITH R.A.E. PROGRAM 187/A FOR USE IN SUPPLEMENTING SPARSE OR UNEVEN DATA
Margaret J. Trigwell Oct. 1966 19 p refs
(RAE-TR-67005; AD-653693) CFSTI: HC $3.00/MF $0.65

The Report describes two extra facilities which are now available with R.A.E. program 187/A (used in connection with

machine tool control). Their purpose is to introduce supplementary data when the original data is sparse or uneven and so to give more satisfactory results when models are cut with numerically controlled machine tools. Author (TAB)

N67-34628 Aircraft Research Association, Ltd., Bedford (England).
PROPELLER SPINNING FACILITY
D. Grundy Jul. 1966 28 p
(ARA-WTN-58)

A design study was conducted to show the feasibility of a proposed 7500 hp propeller test rig and to provide an estimate of the cost. Specifications for the test site, rig pylon, driving motor, and instrumentation are outlined. Several proposed test sites are compared. Proposals for the electricity supply, rig pylon, and foundations are discussed. The general characteristics of four proposed driving motors are described. Miscellaneous equipment items and requirements are briefly mentioned. R.N.A.

N67-34665# Aeronautical Research Council (Gt. Brit.)
DESIGN OF A SUPERSONIC NOZZLE
A. McCabe Aeronautical Res. Council, 1967 38 p refs Supersedes ARC-25716; See X65-15758
(ARC-R&M-3440; ARC-25716) CFSTI: HC $3.00/MF $0.65

This paper presents a method of design of a supersonic nozzle which incorporates recent developments in compressible flow theory. Continuous curvature of the contour is ensured by defining a continuous gradient of Prandtl-Meyer angle along the nozzle axis. The flow in the throat was calculated from results given by Hall (1962). A matching technique was used to determine a triplet of values for the throat radius of curvature, the flow deflection at the inflection point and the Prandtl-Meyer angle at the point on the nozzle axis where the left-running characteristic through the inflection point intersects the nozzle axis. Author

N67-34674# California Univ., Berkeley. Lawrence Radiation Lab.
SELECTION OF A LAMINATION SHAPE FOR A FAST-CYCLING ALTERNATING-GRADIENT MAGNET CORE
H. Paul Hernandez 18 Feb. 1967 11 p refs Presented at the Natl. Particle Accelerator Conf., Washington, D. C., 1–3 Mar. 1967 Submitted for publication
(Contract W-7405-ENG-48)
(UCRL-17264; CONF-670307-40) CFSTI: HC $3.00/MF $0.65

The selection of each dimension of a C-shaped, 18-cps alternating-gradient magnet core lamination is based upon reliability, design, and cost considerations. Cost differentials of magnet-gap height, pole-tip width, return-path widths, etc., are given. Stranded-conductor coils were found significantly more economical to operate than solid conductor coils because of the reduction in eddy-current power. Three cost minimums are discussed: the width of the flux return path, the coil conductor cross section, and the coil aspect ratio. The width of the flux-return path is emphasized and is selected slightly above the minimum cost where the magnetomotive force changes slowly. Author (NSA)

N67-34709# California Univ., Berkeley. Lawrence Radiation Lab.
RF SYSTEM CONSIDERATIONS IN INTERLACED-BEAM INJECTOR SYNCHROTRONS
G. S. Tool and Q. A. Kerns 16 Mar. 1967 9 p refs Presented at the Natl. Particle Accelerator Conf., Washington, D. C., 1–3 Mar. 1967 Submitted for publication
(Contract W-7405-ENG-48)
(UCRL-17451; CONF-670307-43) CFSTI: HC $3.00/MF $0.65

The general characteristics of the rf system high-power components and suitable accelerating structures were studied for several variations of the interlaced multi-ring synchrotron. This type of machine was considered as a possible component of the injection system for the 200-BeV accelerator. Author (NSA)

N67-34725# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
A NEW TYPE OF CAVITY RESONATOR
M. Puglisi and F. Tazzioli 10 Apr. 1967 23 p refs *Its* Nota Interna 361
(LNF-67/29) CFSTI: HC $3.00/MF $0.65

Reported are analytical studies which demonstrate how a loaded resonator can be transformed so as to lower its resonant frequency without reducing the maximum voltages allowable in the starting configuration; and studies which demonstrate how the design value of the resonant frequency in the lowest mode and some of the upper modes may be fixed. The concept on which the proposed transformation is based is that of lengthening as much as possible the path of electromagnetic waves in the resonator by constructing a meander in the resonator. Considered in the analysis are resonant frequencies of coaxial cavities and the resonant frequency of corrugated cavities of the radial type. S.C.W.

N67-34767*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AERODYNAMICS FACILITIES
In its Space Programs Sum. No. 37–45, Vol. IV 30 Jun. 1967 p 61–70

Pictorial data are presented on a biplanar optical system for nonplanar free flight testing. This is based on the concept of splitting the schlieren light path to permit viewing from two angles, and recording the resultant images on a single frame of a high speed 35 mm movie camera. Test conditions are outlined on wind tunnel studies conducted to measure the pressure signatures from hypersonic aircraft at a distance of one model length directly below the model, and to record the normal and moment forces acting on the aircraft. The sting-mounted models included a cone-cylinder, three hypersonic aircraft, and the X-15. Also reported are measurements of equilibrium radiation behind the bow shock at the nose of a model located along the axis of an electric arc-driven shock tube over the temperature range from 9000° to 15,000°K. Indications are that the dominant sources of radiation are the N^- continua and atomic line radiation. Supersonic wind tunnel tests to obtain flow measurements in the near wake of a slender two-dimensional wedge show that gaseous nitrogen or helium injections from the base of the model cause significant changes in the wake structure. M.G.J.

N67-34803# Aeronautical Research Inst. of Sweden, Stockholm.
DOUBLE-DRIVER SHOCK TUBE FOR SHOCK-ON-SHOCK SIMULATION
Bo Lemcke 1967 92 p refs
(FFA-109) CFSTI: HC $3.00/MF $0.65

A novel device for experimental studies of the shock-on-shock interaction on bodies in supersonic flow has been developed. The method utilizes a single shock tube for generating the pre-blast flow as well as the blast shock. The model is stationary during the tests, thus making it possible to take full advantage of all the instrumentation techniques available for shock tube work. The theoretical performance of the device has been analyzed in some detail and the parameters for controlling the flow have been found in connection with specially designed experiments. An important result of the analyses which is mentioned is the fact that an optimum loading set-up has been found that gives the strongest possible blast shock for given preblast flow conditions. Two experimental programs have been carried out to study both the performance of the device and its applications to shock-on-shock interactions on wedges and hemispheres. One program was carried out to study blast effects in the stagnation point region of re-entry vehicles. The other test program was of a more basic nature. In both of the programs data was obtained on the performance of the device and on the shock-on-shock process. Author

N67-34834*# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.
DEVELOPMENT OF VISUAL, CONTACT AND DECISION SUBSYSTEMS FOR A MARS ROVER, JULY 1966–JANUARY 1967
Louis L. Sutro, William L. Kilmer, Roberto Moreno-Diaz, Warren S. Mc Culloch, James G. Bever et al Jul. 1967 112 p refs
(Contract NSR-22-009-138; Grant NGR-22-009-140)
(NASA-CR-87503; R-565) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The first of two efforts described is concerned with communicating pictorial data from a remote location, such as Mars, to Earth. The second deals with developing methods of making decisions at remote locations. Both are instrumentation efforts applicable to a Mars rover and both use biology as a source of ideas. Both efforts are being approached from the viewpoint of development and research. The sections on development consider the tying together of the subsystems, describe three aspects of the visual subsystem (camera–computer chains, processing, and representation of the environment), and describe additions being made to the decision subsystem. The research sections describe McCulloch's concept of the nervous system as interconnected computers; develop mathematically a concept of visual processing, known as lateral interaction, which appears basic to the functioning of higher animal retinas; and describe the theory behind animal learning. R.N.A.

N67-34873# Kernforschungszentrum, Karlsruhe (West Germany). Zyklotron-Laboratorium.
ELECTROMAGNETIC ISOTOPE SEPARATOR IN THE CYCLOTRON LABORATORY OF THE KARLSRUHE NUCLEAR RESEARCH CENTER [DER ELEKTROMAGNETISCHE ISOTOPENSEPARATOR IM ZYKLOTRON-LABORATORIUM DES KERNFORSCHUNGSZENTRUMS KARLSRUHE]
H. Fabricius, K. Freitag, S. Goering, A. Hanser, and H.-J. Langmann Dec. 1966 36 p refs In GERMAN
(KFK-511)

An electromagnetic isotope separator was constructed for the separation of radioactive isotopes with total activities up to several mCi and the separation of stable isotopes for the preparation of very isotope-pure targets in masses up to several mg. The ion optics of the separator are described in detail; the construction and operation of the magnet, ion source, collector, and vacuum installation are also described; and test measurements made are reported. The uses and further development of the separator are indicated. NSA

N67-34889# California Univ., Berkeley. Lawrence Radiation Lab.
REMOTE MAINTENANCE TECHNIQUES PROPOSED FOR THE 22-GeV ACCELERATOR
Roland Krevitt 16 Feb. 1967 11 p refs Presented at the Natl. Particle Accelerator Conf., Washington, D. C., 1–3 Mar. 1967 Submitted for publication
(Contract W-7405-ENG-48)
(UCRL-17195; CONF-670307-44) CFSTI: HC $3.00/MF $0.65

Remote maintenance is one of the prime considerations in determining the size of the main-ring enclosure for the 200-GeV accelerator. The maximum residual radiation level 7 h after beam turn-off is expected to be ≈50 mR/h in the so-called quiet areas of the main ring and approximately 200 R/h at the most intense point in the enclosure. A maximum permissible radiation dose per man of one-half the permissible dose allowed by AEC regulations was assumed. Therefore, an unshielded man can work for a few hours per week in the quiet areas, but only a few seconds per week in the red radiation areas. For these red radial areas, a self-propelled manned shielded vehicle on which are mounted two master-slave manipulators to be used as a backup for extension tools penetrating the vehicle walls was proposed. Author (NSA)

N67-34920# United Kingdom Atomic Energy Authority, Culham (England). Research Group.
HIGH CURRENT SWITCHING USING LOW INDUCTANCE FIELD DISTORTION SPARK GAPS CLOSELY CONNECTED IN PARALLEL
P. M. Barnes, J. E. Gruber, and T. E. James Mar. 1967 34 p refs
(CLM-R71) HMSO: 4s 6d

The development of 60 kV low inductance (15 nH) pressurised field distortion spark gaps is described, and the influence of electrode arrangement and trigger circuit parameters on breakdown time and jitter has been investigated. The necessary conditions for the satisfactory parallel operation of spark gaps with no transit time isolation between them have been deduced theoretically. Such a 60 kV capacitor bank with closely connected parallel spark gaps has been operated successfully. The same principles are being used in the design of multiple arc spark gaps. Author

N67-34999 National Physical Lab., Teddington (England). Aerodynamics Div.
THE AERODYNAMIC INVESTIGATION FOR A GAS-TURBINE EXHAUST TOWER FOR THE WEST BURTON POWER STATION
D. E. Walshe Apr. 1966 18 p refs
(NPL-AERO-1187)

The oscillatory behaviour in steady winds of a multi-flue tower was studied by tests on a dynamic model of the tower mounted in a wind tunnel. Instabilities were found which were consistent with the effects of vortex excitation, but the excitation was weak, and only small amounts of structural damping were necessary to prevent oscillations. Oscillations of the tower in steady winds are therefore not expected. Author

N67-35028# California Univ., Berkeley. Lawrence Radiation Lab.
CAPABILITY VS COST FOR SERVICING AND HANDLING SYSTEM CHOICES IN 200-GeV ACCELERATOR STUDY
W. W. Salsig 15 Feb. 1967 19 p refs Presented at the Natl. Particle Accelerator Conf., Washington, D. C., 1–3 Mar. 1967
(Contract W-7405-ENG-48)
(UCRL-17247; CONF-670307-39) CFSTI: HC $3.00/MF $0.65

Unprecedented size, residual radiation, and the need for quite reliable operation of the 200-GeV accelerator present new challenges in servicing and maintenance. Yet costs must not be disproportionately large. An example servicing solution is developed, and variations are investigated for costs. It is shown that large percentage cost changes are not to be expected, but that small changes can represent millions of dollars. Therefore extraordinary care should be exercised in refining appropriate solutions. The era of thorough preconstruction mock-up work has arrived in the accelerator business! Author (NSA)

N67-35030 Centro di Studio per la Fisica delle Microonde, Florence (Italy).
ACTIVITIES OF CENTRO MICROONDE DURING 1966
1966 128 p refs

A descriptive booklet is presented on the work of the Microwave Center, near Florence, Italy, for theoretical and applied research in the field of microwaves, electronics and electromagnetic waves. The principal facilities and buildings are shown, and the scientific instruments and equipment are listed. One facility, the propagation laboratory, consists of a large absorbing hall and is equipped for experiments on electromagnetic wave radiation. The tower will be used for observations on antennas having automatic equipment. Current research is briefly outlined. R.U.

N67-35084 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany). Institut fuer Angewandte Gasdynamik.
FORCE MEASUREMENTS ON BLUNT BODIES IN THE DVL GUN TUNNEL (M=8 TO 16) [KRAFTMESSUNGEN AN STUMPFEN KOERPERN IM DVL-STOSSWELLENWIND-KANAL MIT FREIFLIEGENDEM KOLBEN (M = 8 BIS 16)]
Alfred Heyser, Wolfgang Wyborny, and Hans-Peter Kabelitz Aug. 1967 42 p refs In GERMAN; ENGLISH summary Presented at the DGRR/WGLR Ann. Conf., Bad Godesberg, W. Germany, Oct. 1966
(DLR-FB-67-53; DVL-668)

Construction of the tunnel and the three-component-balances based on strain gauge systems are described. The usefulness of the test results is shown by comparison with the results of other institutes for the AGARD-calibration models HB-1 and HB-2. Test results of three-component-measurements on different blunt nosed bodies are compared with the results of the Newtonian theory. The influence of spikes of different length on drag and lift of blunt bodies is discussed for different angles of attack. Author

N67-35083# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE SIMULTANEOUS DETERMINATION OF LEAD CONTENT IN THE AIR OF A WORKING PLACE BY FOUR LABORATORIES
Rolf Mappes *In its* Hyg. Effects and Control of Dusts, Fogs, Gases, Vapors, Radioact. Particles 1966 p 15–18 (See N67-35081 20-34)

Four laboratories checked the reliability of their analytical methods by carrying out, at the same time and place, determinations of lead present in the air. After taking into account many possible errors, in spite of the fact that different instruments and analytical methods were used, it was possible to measure lead dust concentrations below the MAK value (200μ g Pb/m^3) with deviations up to ±15% (49 out of 51 values). In the case of concentrations below the MAK value the disparities were only slightly higher. This accuracy is quite sufficient for most problems of industrial hygiene. Author

N67-35143# Joint Publications Research Service, Washington, D. C.
COMMUNIST CHINA'S NUCLEAR BASE AT LANCHOW
I-hung Chin and Jung-sheng Huang *In its* Transl. on Communist China's Sci. and Technol., No. 386 13 Jul. 1967 p 14–32 refs Transl. into ENGLISH from Chin Jih Ta Lu (Nationalist China), no. 241, 1 Oct. 1965 p 8–15 (See N67-35143 20-34)

The geography of the Lanchow (Lan-chou) area in northwestern China is described, and a brief history of the region is presented. The region harbors a gas diffusion plant vital to Communist China's nuclear base. The organization of the Lanchow Center for Scientific Research, which engages in several scientific pursuits, is described; and the large manpower provided for the Center is noted. The distribution of uranium deposits in the vicinity of Lanchow, in the upper reaches of the Yellow River, and to the south of Inner Mongolia, are discussed. The concentration of platinum, titanium, and chromium deposits of Ch'i-lien-shan is noted. The organization and productivity of the Lanchow gas diffusion plant; and the estimated capital investment for the Lanchow nuclear base are discussed. L.S.

N67-35155# Istituto Superiore di Sanita, Rome (Italy). Laboratori de Fisica.
DEVICE FOR THE AUTOMATIC LOADING OF LIQUID AIR VACUUM TRAPS [DISPOSITIVO PER IL CARICAMENTO AUTOMATICO DI TRAPPOLE PER VUOTO AD ARIA LIQUIDA]
R. Crateri 8 Nov. 1966 11 p In ITALIAN; ENGLISH summary
(ISS-66/41) CFSTI: HC $3.00/MF $0.65

The technical arrangement and the functioning of a high vacuum system for automatically refilling liquid air traps are presented. This study was undertaken to find a method of eliminating oil vapors generated by the diffusion pump. Two electromagnetic valves regulate the flux of nitrogen in the circuit. Transl. by R.U.

N67-35226# Los Alamos Scientific Lab., N. Mex.
INITIAL WARMUP OF 500,000-GALLON LIQUID HYDROGEN DEWAR
D. H. Leibenberg and E. Murley 22 Mar. 1967 9 p refs
(Contract W-7405-ENG-36)
(LA-3661) CFSTI: HC $3.00/MF $0.65

A 500,000-gal liquid hydrogen dewar was warmed to ambient temperature by breaking the annular space with a small quantity of gaseous nitrogen and using an installed 32.3-kW electric heater. Some previously reported hazards were not observed using this procedure. Observations indicated the energy required to warm the perlite insulation is less than that calculated using present theory. (NSA)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N67-34005# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
FLOW REGIMES AND PERFORMANCE OF STRAIGHT ANNULAR DIFFUSERS HAVING EQUAL INNER AND OUTER CONE ANGLES
H. J. Henseler and J. H. G. Howard Aug. 1966 67 p refs
(Grant NRC-A-2742)
(RR-3)

Annular diffusers having straight walls and equal inner and outer cone angles have been investigated. Analytical methods for predicting boundary layer growth, shape factor, and separation have been reviewed and were found to be inadequate. Experiments have been performed, using air flow without swirl discharging into the atmosphere, to obtain performance and flow regime information for annular diffuser geometries from 7° to 20° cone angle. Lines of first appreciable stall and fixed stall have been located and the performance data allows the solution of the four common optimum problems in diffuser design. The behaviour of the tested annular diffusers has been found to be similar to plane diffusers which share a common relationship between area ratio, length, and angle. They do not agree with conical diffuser characteristics which have a different area ratio relationship. Author

N67-34009# RAND Corp., Santa Monica, Calif.
A PROGRAM FOR CALCULATING RADIATION FLOW AND HYDRODYNAMIC MOTION
H. L. Brode, W. Asano, M. Plemmons, L. Scantlin, and A. Stevenson Apr. 1967 411 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5187-PR; AD-653965) CFSTI: HC $3.00/MF $0.65

The report contains a numerical program for solving hydrodynamic flow and radiation transport problems in the diffusion and grey-body approximations. The program is appropriate to the solution of explosion and shock wave problems, and to the study of high explosive or nuclear fireballs, hot gas dynamics, deflagrations and detonations, bubble phenomena, shock tube flows, and can be adapted to a host of other dynamics problems. It is restricted to plane, cylindrical, or spherical symmetry. The report offers (1)

a description of the assumed physical model, (2) a rationale for the difference equations and integration techniques used in the mathematical formulation, (3) a complete set of flow diagrams for the program and its subroutines, (4) a listing of the code, (5) two illustrative example calculations for hydrodynamics and for radiation flow, and (6) helpful hints for checking and running versions of the program. Author (TAB)

N67-34029# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.

ON THE LAMINAR MOTION OF A FLUID NEAR AN OSCILLATING POROUS, INFINITE PLANE

W. B. Nicoll, A. B. Strong, and K. A. Woolner Jan. 1967 16 p refs

(TN-1) CFSTI: HC $3.00/MF $0.65

A solution is presented to the problem of the laminar flow of a fluid near a porous harmonic oscillating surface in which the effect of this disturbance on the motion of the surrounding fluid and the influence on this motion by mass transfer through the surface are determined. R.N.A.

N67-34049# Ballistic Research Labs., Aberdeen Proving Ground, Md.

SOLUTION OF THE TWO-SIDED CAUCHY PROBLEM FOR AN m-DIMENSIONAL GENERALIZED ACOUSTIC SYSTEM

Abdul R. Kiwan May 1967 24 p refs

(BRL-R-1364; AD-653789) CFSTI: HC $3.00/MF $0.65

J. B. Diaz and R. Landshoff gave closed form solution of the initial-value problem for an acoustic system in two dimensions. A. R. Kiwan gave the solution of the same problem in two and three space dimensions, and improved the results of Diaz-Landshoff. The present report solves the problem for m-dimensions and deduces the earlier results as special cases. Author (TAB)

N67-34055# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

MECHANISMS IN THE GENERATION OF AIRBLASTS BY UNDERWATER EXPLOSIONS

Charles I. Malme, Jaime R. Carbonell, and Ira Dyer White Oak, Md., Naval Ordnance Lab., 23 Sep. 1966 161 p ref

(Contract N60921-7025)

(BBN-1434; NOLTR-66-88; AD-654175) CFSTI: HC $3.00/MF $0.65

Research studies and small-scale experimental tests were conducted to explore the formation and propagation of airblasts resulting from underwater explosions. Deep explosions produce an interface velocity above the charge that is subsonic in air. The resulting airblast signature was found to be produced by acoustic radiation from a large surface area following the passage of the transmitted shock. In general, the interface velocity could not be predicted by linear continuous theory because of cavitation and subsequent separation of the surface layers near the charge. When the interface velocity above the charge is supersonic, the character of the airblast signature becomes more shocklike and the explosion is said to be shallow. While the airblast generating mechanisms of deep explosions are still present, their effect is generally overshadowed by the shock wave associated with the supersonically rising dome and plume. The intensity of this shock is closely related to the Mach number of the plume. This permits an approximate calculation of the peak airblast pressure using existing theory of off-axis shock-wave generation by supersonic blunt bodies. Author (TAB)

N67-34109# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.

PERFORMANCE OF THIN TURNING VANES IN SQUARE CONDUITS

Shabeer Ahmed and E. Brundrett May 1967 56 p refs

(Grant DRG-G-9559-18)

(RR-6) CFSTI: HC $3.00/MF $0.65

Experimental investigations were carried out on a 90° corner with thin circular arc turning vanes in a tunnel 2 feet square. The turning vanes were of 6 inch radius to match the curvature of the bend, and were a quarter of a circumference in length. The intended applications of the results were for low speed closed circuit type wind tunnels, and other duct flows. The parameters varied were the Reynolds number based on vane chord length and the pitch-chord ratio of the cascade. The results were compared with data obtained from cascades having equally spaced vanes and comparable pitch/chord ratios. The aim was to find how the performance of the cascaded bend depended on: 1) the velocity profile downstream of the bend, 2) the corner loss coefficient, and 3) the secondary flow coefficient. It was found for optimum performance, that the best cascade contained a graded spacing of vanes rather than the conventional equally spaced arrangement, the spacing being closest on the near and far sides of the corner. Author

N67-34185# Washington Univ., Seattle. Dept. of Atmospheric Sciences.

INVESTIGATION OF A PARTICULAR MODE OF INSTABILITY FOR AN IDEALIZED VORTEX MODEL

K. H. Bergman *In its* Convective Elem. Apr. 1967 p 27–68 refs (See N67-34181 20-13)

Stability analyses for viscous flows are critically assessed and an erroneous sequence of analysis is corrected. Instability of a particular mode of distribution for an idealized viscous vortex model is analyzed in detail. A uniform convergence solution is used to define the undisturbed flow. The critical scale of turbulence at which transition from the laminar to the turbulent vortex profiles takes place is investigated using the linearized theory of small disturbances superimposed on the mean, or undisturbed, laminar flow. Overall results of the analysis indicate that, in most cases, an idealized steady state vortex model is stable with respect to small periodic disturbances in the horizontal plane. E.C.

N67-34245# Ministry of Aviation, Pinner (England). Technical Information and Library Services.

INCREASING THE EFFICIENCY OF TURBINE DELIVERY SYSTEMS [POVYSHENIE EFFEKTIVNOSTI VY KHLOPNYKH PATRUBKOV TURBIN]

D. I. Morozov Apr. 1966 10 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), v. 5, 1965 p 35–37

(TIL/T-5661) CFSTI: HC $3.00/MF $0.65

Mathematical analysis of turbine diffusers and delivery systems, and means of increasing their efficiency by the introduction of an involute volute and a peripheral grid to ensure a radial outflow from the diffuser without disruption of flow are discussed. Assessment of the losses in the diffuser and volute and a mathematical evaluation of the optimum rate of expansion, based on the development of the overall radial dimensions and the effective outlet section of the volute are presented. It is shown that the design principles described can be recommended for increasing the efficiency of turbine delivery systems. Author

N67-34283# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.

ESTIMATION OF SHEAR STRESS AND HEAT TRANSFER FOR NON-SIMILAR, LAMINAR BOUNDARY LAYERS

H. L. Evans and A. B. Strong Aug. 1966 74 p refs

(RR-2) CFSTI: HC $3.00/MF $0.65

Merk has proposed a method of boundary layer analysis for nonsimilar flows which is rapid, reliable and, as far as can be judged, accurate. The formulas are obtained from a special type of series solution to the partial differential equations of the boundary layer; both two-dimensional and axisymmetrical flows are included. Numerical data are given relating to the first two terms in the series, which cover the ranges $-0.19 \leq \beta \leq 1.0$ in the pressure gradient parameter and $0.5 \leq \sigma \leq 1.0$ in Prandtl number. The method

compares well with other accurate methods of predicting heat transfer; agreement with experiment is satisfactory, but there are few accurate measurements for which the effects of turbulence are known to be negligible. There is evidence that the use of the first term alone, namely that obtained from "similar" solutions with pressure gradient, may give highly accurate estimates of heat transfer. Author

N67-34347# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering and Process Technology Div.
ROUGH TUBE FRICTION FACTORS AND HEAT TRANSFER COEFFICIENTS IN LAMINAR AND TRANSITION FLOW
J. Molloy Mar. 1967 27 p refs
(AERE-R-5415) CFSTI: HC $3.00/MF $0.65

An experimental program on the friction factors and heat transfer from one smooth and one rough tube is described. The experiments were carried out at low Reynolds numbers (1,400 to 40,000) and the results are compared with other experimental data and with a theoretical analysis of laminar flow heat transfer. In the laminar regime the behaviour of both types of surface was found to be identical. Beyond the critical Reynolds number the Stanton number for the roughened tube rose continuously with Reynolds number over the range tested (up to $Re \approx 8000$) whereas that for the smooth tube passed through a maximum. The friction factor data indicated a range in the transition region where the rough tube could actually give a lower value than the smooth one. Author

N67-34382 Royal Aircraft Establishment, Farnborough (England).
A CONTRIBUTION OF THE CALCULATION OF TURBULENT BOUNDARY LAYERS IN TWO-DIMENSIONAL INCOMPRESSIBLE FLOW [BEITRAG ZUR BERECHNUNG TURBULENTER GRENZSCHICHTEN IN ZWEIDIMENSIONALER INKOMPRESSIBLER STROEMUNG]
K. O. Felsch Mar. 1967 110 p refs Transl. into ENGLISH from the German Rept. DLR-FB-66-46, Jul. 1966
(RAE-LIB-TRANS-1219; DLR-FB-66-46)

A new semi-empirical law is deduced for the dissipation integral which, in contrast to the laws known up to now, takes account of the "history" of the boundary layer. From a physical point of view this means that in general the shear distribution is not uniquely connected with the mean velocity distribution. An essential prerequisite for the practical application of the new law is a one-parameter representation of a convenient form parameter of the mean velocity profile as a function of the condition of compatibility at the wall. It is shown by calculated examples that turbulent boundary layers and their separation, even in difficult cases, can be calculated much more accurately by the new dissipation law than by the approximate theories known up to the present day. Author

N67-34622# General Electric Co., Philadelphia, Pa. Missile and Space Div.
SURFACE INTERACTIONS IN FREE-MOLECULE-FLOW II: REFLECTED PARTICLE VELOCITY DENSITY FUNCTION MODEL
T. Marshall (Pa. Univ.) 21 Oct. 1966 26 p refs
(AFM-66-17)

A previous study of gas-surface interactions recommended the development of an empirical model for the reflected particle velocity distribution (i.e. a density function). Such a model, based on a Maxwellian distribution of thermal velocities with a superimposed directed velocity and different distributions for each velocity component, is described in detail in this report. Determination of the model parameters from different types of experimental data and the effect of type of data on uniqueness of the model are discussed. Suggestions for correlation of model parameters with gas-solid properties are presented. Author

N67-34673# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
ONE-DIMENSIONAL UNSTEADY FLOW OF A RADIATING GAS
Ephraim L. Rubin, Chester Gerstenbluth, and Prem K. Khosla May 1967 19 p refs
(Contract Nonr-839(34))
(PIBAL-990; AD-653443) CFSTI: HC $3.00/MF $0.65

The unsteady hydrodynamical equations are solved for a radiating gas, using a Lax-Wendroff type technique which is second-order accurate. Author (TAB)

N67-34701# McGill Univ., Montreal (Quebec). Mechanical Engineering Research Labs.
TWO-DIMENSIONAL TURBULENT WALL JETS OVER CURVED SURFACES
D. E. Guitton Feb. 1967 60 p refs Supersedes MERL-TN-64-7 See N65-22486
(Grant DRB-9551-12)
(MERL-TN-67-1; MERL-TN-64-7) CFSTI: HC $3.00/MF $0.65

This note provides corrections and additions to the report, Two-Dimensional Turbulent Jets Over Curved Surfaces. A brief review of the original method of analysis is included herein and the points to be changed are noted. The new and modified theories are compared with both the original experiments on constant radius surfaces and with new published data on self-preserving cases. Revised conclusions are then drawn. Author

N67-34720 Ministry of Technology, London (England).
ON THE BREAKDOWN OF NEAR-EQUILIBRIUM QUASI-ONE-DIMENSIONAL FLOW
P. A. Blythe HMSO, 1967 30 p refs Supersedes NPL-AERO-1090; ARC-27588; See X66-21482
(ARC-CP-923; NPL-AERO-1090; ARC-27588) HMSO: 6s

The limitations of near-equilibrium solutions in expanding non-equilibrium flows are discussed. The breakdown of this type of solution far downstream is investigated for a vibrationally relaxing gas. It is shown that valid asymptotic solutions can be derived by the use of matching techniques. Asymptotic frozen levels of the vibrational energy are obtained for a particular flow model. Author

N67-34752 Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
NON-NORMAL SIMILAR TURBULENT BOUNDARY LAYERS
B. E. Launder and H. S. Stinchcombe May 1967 51 p refs
(TWF/TN/21)

In an acceleration between converging planes the acceleration parameter is constant at all stations and the turbulent boundary layer in such an acceleration is completely similar. Results of an experimental study of turbulent boundary layers developing between converging planes for values of the acceleration parameter in the range $0.7\text{–}3.0\times10^{-6}$ are presented. As K was progressively increased, the similar boundary layers exhibited a continuous shift from a typically turbulent velocity profile towards a shape akin to a laminar boundary layer. For this reason these turbulent boundary layers are labelled nonnormal. A high longitudinal turbulence intensity remained even at the highest value of K though the bulk of this turbulent energy was associated with irrotational fluctuations. It seems probable that the value of the skin friction coefficient for nonnormal boundary layers is essentially constant even though the layer's structure undergoes such radical changes. By considering the time required for the mean and turbulent kinetic energy to change appreciably, it has been deduced that the parameter which marks the onset of laminarization is $K.c_f^{-3/2}$ Author

N67-34754# Australian Aeronautical Research Committee, Melbourne.
A SURVEY OF COMPRESSIBLE FLOW BOUNDARY LAYERS—THEORY AND EXPERIMENT
H. G. Hornung Feb. 1966 42 p refs
(ACA-67)

A review is presented on the more important literature concerning laminar and turbulent boundary layers in the compressible flow of an undissociated, un-ionized gas at large Reynolds numbers, zero transverse pressure gradient, and negligible body forces. An outline of the state of the knowledge in this field is given, and some areas of ignorance are delineated. Theories as well as experimental results are treated and compared. Author

N67-34776*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FLUID PHYSICS
In its Space Programs Sum. No. 37-45, Vol. IV 30 Jun. 1967 p 244-250 refs (See N67-34761 20-30)

An experiment is described in which spherical models are sting-mounted in either a M=4.2 nitrogen stream, or a M=3.8 argon stream. The Reynolds number (Re) is varied by changing both the model size and the total pressure of the flow. It is pointed out that for large Re, the disturbance is characterized by a discontinuous shock wave standing close to the body (inviscid solution), while for small Re the shock wave is replaced by a smooth disturbance which extends far upstream (free molecular solution). The transition of the flow between these two limiting solutions is sought. Stagnation streamline data are plotted for a 1/2 in. sphere in nitrogen with Re=100, and M=4.4. Figures depict the density distribution along the stagnation streamline of spheres for various Re in nitrogen. Consideration is also given to the stability of viscous three-dimensional disturbances in the laminar compressible boundary layer. The sixth-order system was used to calculate the time rate of amplification as a function of wave number, wave angle, Re and M in the indicated number range. The results are given on the effects of wave angle and Re on the amplification rate of first-mode three-dimensional disturbances. M.G.J.

N67-34899*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN EXPERIMENTAL INVESTIGATION OF THE FREQUENCY AND VISCOUS DAMPING OF LIQUIDS DURING WEIGHTLESSNESS
Jack A. Salzman, Thomas L. Labus, and William J. Masica Washington, NASA, Aug. 1967 20 p refs
(NASA-TN-D-4132) CFSTI: HC $3.00/MF $0.65 CSCL 20D

As a part of the general study of liquid behavior in weightlessness, an experimental drop-tower investigation was conducted to determine liquid sloshing characteristics in a zero Bond number environment. The frequency and damping of the fundamental asymmetric sloshing mode in right-circular cylinders (radii ranging from 0.159 to 1.27 cm) were correlated in terms of known system parameters. Contact angles were restricted to very near zero degrees such that the sloshing equilibrium interface was highly curved. Liquid depths were greater than 1 diameter from the cylinder bottom. Author

N67-34929# Cornell Univ., Ithaca, N. Y.
PROPAGATION OF DENSITY FLUCTUATIONS IN DENSE MONATOMIC FLUIDS
Subramanian Ranganathan (Ph.D. Thesis) Feb. 1967 113 p refs
(Contract AT(30-1)-3326)
(NYO-3326-15) CFSTI: HC $3.00/MF $0.65

The Fourier transform $S(K,\omega)$ of the time-dependent density-density correlation function $G(\vec{r},t)$ has been calculated using the linearized Boltzmann equation in the case of dilute gases and the Enskog and the Vlasov equation in the case of dense fluids. The approach consists of solving an initial value problem for a small density disturbance and identifying $G(\vec{r},t)$ as the velocity integral of the distribution function. In the case of Maxwell molecules for a dilute gas, the exact results of $S(K,\omega)$ have been compared with those of the Navier-Stokes and Burnett equations of hydrodynamics. To be able to solve the Enskog equation for $S(K,\omega)$, the interactions terms have to be approximated. To apply the Vlasov equation to classical fluids, the intermolecular potential in the equation has to be replaced by the direct correlation function. It also predicts the propagation of a collisionless sound at some wave numbers. Author (NSA)

N67-34980*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF FLUID PROPERTIES AND GRAVITY LEVEL ON BOILING IN THE DISCRETE BUBBLE REGION
Thomas H. Cochran and John C. Aydelott Washington, NASA, Aug. 1967 26 p refs
(NASA-TN-D-4070) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The effects on boiling of changes in fluid properties and gravity level were investigated for liquids of high viscosity (a sucrose solution) and low surface tension (an ethanol-water solution) in relation to water. The zero-gravity data were obtained by allowing the experiment package to free fall in a 2.25-second drop tower, which permitted the attainment of less than 10^{-5} times earth gravity. Data taken from high-speed motion pictures indicate that viscous effects were negligible during the growth of bubbles. However, in zero gravity, the viscous effects were important near bubbles separation for the sucrose solution. Bubbles generated in the ethanol-water solution had similar maximum radii and lifetime characteristics in normal and zero gravities. Author

N67-35037*# Pennsylvania State Univ., University Park. Graduate School.
THERMODYNAMIC EFFECTS ON DESINENT CAVITATION IN WATER
Alain L. Kornhauser (M.S. Thesis) Jun. 1967 178 p refs
(Grant NsG-85)
(NASA-CR-87472) CSCL 20D

Thermodynamic effects on the amounts of cavitation and other variables at several values of free stream velocity and model size were studied experimentally and theoretically. Cavitation numbers for given cavitation conditions were found as a function of temperature for two sizes of hemispherical nosed models over a temperature range from 80 to 260°F. Theoretical predictions were obtained by numerically solving the complete Rayleigh-Plesset single vapor bubble dynamics equation and by determining the temperature at the bubble wall. Also considered were the effects of initial nuclei size; initial permanent gas pressure; boundary layer thickness; buoyancy, cohesion, and drag force; model size; and free stream velocity. Comparisons of the analytical results with the experimental results indicate that an extremely exaggerated thermodynamic effect was predicted by this non-isothermal solution as a result of neglected convective heat and mass transfer. In almost all experimental cases, desinent cavitation numbers increased substantially with increasing temperature. G.G.

N67-35062 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Aachen (West Germany). Institut fuer Theoretische Gasdynamik.
ON THE PROPAGATION OF MUZZLE BLAST WAVES [UEBER DIE AUSBREITUNG DES MUENDUNGSKNALLES]
Wilhelm Schneider Jul. 1967 80 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-50; DVL-667)

After a projectile has left the muzzle the propellant gases flow out from the gun and produce a pressure wave in the surrounding air. The jetting of gases has an effect on the directivity of the wave. The propagation of the shock formed at the front of

this wave is investigated in this paper. At large distance from the muzzle, the complex outflow process is replaced by a superposition of unsteady singularities (source, dipole, quadrupole) located at the muzzle-center. With such a mathematical model the source- and the momentum-effects of a gun having a bare muzzle or having a muzzle brake can be represented. Equations are developed in order to calculate the pressure change across the shock of the muzzle blast wave. The application of these formulas is illustrated in some examples. Results of the theory are compared with experiments. Author

N67-35067 National Physical Lab., Teddington (England). Aerodynamics Div.
INDUSTRIAL AERODYNAMICS: A SURVEY OF RESEARCH IN THE UNITED KINGDOM
E. W. E. Rogers and R. E. Whitbread Jul. 1966 117 p refs
(NPL-AERO-1200)

A survey has been made of current and recent research activity in the United Kingdom on non-aeronautical aerodynamics, in which particular attention has been paid to the problems of studying wind loading on buildings and structures, and those connected with duct flows. Other topics covered include heat-transfer effects, the aerodynamics of vehicles and rotating machinery, two-part, mixing and boundary flows, and the aerodynamics of fluid-logic devices. Author

N67-35068 National Physical Lab., Teddington (England). Aerodynamics Div.
ON THE EFFECTS OF A PERIODIC, SPANWISE VARIATION OF SUCTION UPON THE ASYMPTOTIC SUCTION FLOW
R. E. Kelly Oct. 1966 50 p refs
(NPL-AERO-1202)

The analysis concerns the effect of a spanwise periodic variation of streamwise vorticity upon the two-dimensional asymptotic suction flow. Such vorticity, generated in this case by imposing a spanwise variation in the suction velocity, is known to play an important role in unstable and turbulent boundary layers. The flow induced by the variation has been obtained for cases when the freestream velocity is steady, oscillates periodically with time, and changes impulsively from rest. For the oscillatory case, it is shown that a frequency exists which maximizes the induced, unsteady wall shear stress for a given spanwise period. For the case of steady flow, the heat transfer has also been computed for the case of a wall at constant temperature. Author

N67-35114*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL RESULTS OF HEAT TRANSFER AND PRESSURE DROP OF ARGON FLOWING THROUGH SINGLE TUBE WITH INTERNAL INTERRUPTED FINS
David Namkoong and Michael P. Lynch Washington, NASA, Aug. 1967 19 p refs
(NASA-TM-X-1428) CFSTI: HC$3.00/MF$0.65 CSCL 20M

A 1-1/4-inch (3.18 cm) tube with internal, interrupted fins was tested with argon. Friction factors were calculated from data with and without heat addition. Values of the heat-transfer parameter $N_{St}N_{Pr}^{2/3}$ were also obtained, where N_{St} is the Stanton number and N_{Pr} is the Prandtl number. Plotted against Reynolds number up to 2200, the friction factor and the heat-transfer parameter curves were similar to those of a louvered plate-fin geometry with the same interrupted fin length. Author

N67-35183# Institut Franco-Allemand de Recherches, St. Louis (France).
MACH NUMBER FUNCTIONS TABLES ACCORDING TO WHITHAM'S THEORY [TABLES DE FONCTIONS DU NOMBRE DE MACH INTRODUITES DANS LA THEORIE DE WHITHAM]
F. Hagry 9 May 1966 27 p refs In FRENCH
(ISL-T-10/66) CFSTI: HC$3.00/MF$0.65

These tables show the shock wave propagation values in static air as functions of Mach number and wave intensity (pressure) and of five more theoretical values in accord with the Whitman rule. These values have a decisive significance in numerical determination of the parameters that control shock wave propagation. Author

N67-35253*# Connecticut Univ., Storrs. Dept. of Mechanical Engineering.
AN ANALYTICAL AND EXPERIMENTAL STUDY OF THE TWO-PHASE FLOW OF A HIGH VELOCITY VAPOR CONDENSING IN A TUBE, PART II
Winthrop E. Hilding Aug. 1967 183 p refs
(Grant NsG-204-6252)
(NASA-CR-78853) CSCL 20D

A mathematical model; the simplifying assumptions adopted; and the method of analytical attack are described. Construction details of the experimental apparatus used are given, along with a discussion of the problems and fundamental errors encountered in obtaining useful experimental data. The major results of the investigation are presented graphically, with a graphical comparison of the experimental and analytical data. The significance of the important results are discussed. Derivations and computational details concerning the physical properties of saturated vapors and liquids; differential equations for the flow continuity, flow momentum, energy transfer, and velocity pressures; heat transfer surface coefficients; and interfacial and wall shear stress are given. L.S.

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N67-34018 Royal Swedish Academy of Sciences, Stockholm. Kiruna Geophysical Observatory.
MEASUREMENT OF THE ENERGY SPECTRA AND ANGULAR DISTRIBUTIONS OF ELECTRONS IN THE NORTHERN LIGHTS [MESSUNG DER ENERGEISPEKTREN UND WINKELVERTEILUNGEN VON ELEKTRONEN IM NORDLICHT]
Oct. 1966 96 p refs In GERMAN
(Rept.-663)

Direct rocket measurements were made of the polar aurora to supplement data obtained by ground observations. Measured were energy spectra and angular distributions in relation to the geomagnetic field direction of high-energy electrons in a polar aurora of medium intensity. Simultaneous observation of the galactic noise indicated an absorption of 1.5 dB. A Nike–Apache rocket was used in the experiments. Measurements were made with a solid state detector that permitted differentiation between electrons and protons. The energy range selected for measurements was from 40 to 104 keV. The rocket attained an apogee of 146.5 km, and reliable values were obtained at altitudes above 80 km. Transl. by K.W.

N67-34020# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
ON THE THEORY OF DETERMINING THE TOPOGRAPHIC SURFACE OF THE EARTH, PART II [K TEORII OPREDELENIYA TOPOGRAFICHESKOY POVERKHNOSTI ZEMLI]

I. F. Monin May 1967 16 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Geod. i Aerofotos. (Moscow), no. 6, 1965 p 71–76
(ACIC-TC-1172; TT-67-62145; AD-653951) CFSTI: HC $3.00/MF $0.65

Two methods were developed for the solution of the integral equation in relation to the density of the potential of a simple layer. Equation one (1) is integral-differential, and is transformed in this article. A solution for integral equation two (2) is given using the method of the indefinite parameter. TAB

N67-34028*# Texas Univ., Austin.
MEASUREMENT OF DYNAMIC CHARACTERISTICS OF SOILS WITH PENETROMETERS
David P. Womack and William R. Cox Washington, NASA, Aug. 1967 124 p refs
(Contract NAS9-3559; Grant NsG-604)
(NASA-CR-849) CFSTI: HC $3.00/MF $0.65 CSCL 08M

The response of various soils to dynamic loads was studied by use of an impact penetrometer. A similar static penetrometer test was employed to determine any correlation between the static and dynamic cases, and to augment the evaluation of the important soil parameters affecting the impact mechanism. Target media selected for testing were two poorly graded sands, a well graded sand, a clay, and a crushed stone. The moisture contents and densities of the sands were varied widely during testing, while the clay was tested *in situ*. Observations showed that the soil-projectile interaction generally agreed with existing failure theories for impacts, and that the shearing strength of the soil apparently is a principal factor. It was found that impacts in granular soil were influenced greatly by the amounts of water and air in the target materials, and that no direct correlation exists between static and dynamic tests when these constituents are varied. Remote target evaluation employing penetrometer techniques is feasible if the penetrometer is properly tested and calibrated with respect to possible target conditions and impact velocities. Author

N67-34064# Kiruna Geophysical Observatory (Sweden).
A SYSTEM FOR AUTOMATIC COLLECTION OF GEOMAGNETIC DATA IN DIGITAL FORM Final Scientific Report
Georg Gustafsson 10 Feb. 1967 24 p refs
(Contract AF 61(052)-237)
(AFCRL-67-0281; AD-653607) CFSTI: HC $3.00/MF $0.65

An equipment has been constructed and built for automatic collection of geomagnetic data. The report gives a summary of the scientific and technical achievements which have been made under the contract. A short description is also given of the data processing from raw data into a form suitable for publication in the traditional magnetic yearbook form. Author (TAB)

N67-34072# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
THE GEOLOGICAL STRUCTURE OF THE USSR. VOLUME 3: TECTONICS, PART I
L. I. Krasnyy, ed. 1967 359 p ref Transl. into ENGLISH from the book "Geologicheskoye Stroyeniye SSSR. Tom 3: Tektonika" Moscow, Gosgeoltekhizdat., 1958
(ACIC-TC-1122, Pt. I; TT-67-62023; AD-652480) CFSTI: HC $3.00/MF $0.65

The study contains a two part translation of the tectonic features of the Soviet territory. The first portion of the section is devoted to a regional description of Soviet tectonics. The second portion is devoted to the history of tectonic development on Soviet territory. Author (TAB)

N67-34080# National Oceanographic Data Center, Washington, D. C.
THE VARIABILITY OF WATER MASSES IN THE INDIAN OCEAN
James F. Gallagher (M.S. Thesis—Am. Univ.) 1966 84 p refs
(G-11)

A delineation of the boundaries of the subsurface water masses of the Indian Ocean is accomplished by means of temperature-salinity graphs of oceanographic stations which are located along intersecting cross-sectional lines. Circulation and properties of the surface water as well as the deep and bottom water are discussed. Author

N67-34110# Meteorology Research, Inc., Altadena, Calif.
EXPERIMENTAL AND THEORETICAL STUDY OF THE MARINE AND CONTINENTAL CLIMATES OF THE POINT CONCEPTION TO MORRO BAY REGION OF CALIFORNIA Interim Technical Report
J. A. Roberts 27 Jun. 1967 27 p refs
(Contract DA-31-124-ARO-D-437)
(MRI67-IR-613; AD-653840) CFSTI: HC $3.00/MF $0.65

The report summarizes the first year of work by Meteorology Research, Inc., on 'An Experimental and Theoretical Study of the Marine and Continental Climates of the Point Conception to Morro Bay Region of California.' The objectives of this study are to provide a partial understanding of the marine elements of coastal climatic classification, a better understanding of the effects of meteorology and marine conditions on mesoclimatology of the coast, and a basis for the prediction of weather conditions on coastal areas of similar classifications. The principal instruments used in the program were nine mechanical weather stations; supporting meteorological data were collected by aircraft and field observations and from cooperating observers. A preliminary mesoclimatology of the coastal regions has been prepared. The three principal mesoclimatic types which have been identified are those associated with exposed lowlands, those associated with exposed headlands, and those associated with protected headlands or lowlands. The primary element causing these mesoclimatic differences is wind. A continuing program is now under way to quantify the conditions that have been observed qualitatively during the first year. The final results of the study will be published in a two-volume 'Atlas of Mesoclimatology of the Point Conception to Morro Bay Region of California.' Author (TAB)

N67-34116# RAND Corp., Santa Monica, Calif.
ON THE HEAT EFFECT OF THE 15-MICRON BAND OF CARBON DIOXIDE IN THE UPPER ATMOSPHERE
G. M. Shved May 1967 41 p refs
(P-3596; AD-653931) CFSTI: HC $3.00/MF $0.65

The heating effect of the 15 micron band of CO_2 in the mesosphere is estimated based on the approximation of the isolated line. The Voigt line profile and temperature dependence of line intensities are taken into account, but vibrational relaxation is not. The latter affects the magnitude but not the sign of the heating rates above about 75 km. The principal result is that although the 15 micron band cools most of the mesosphere, it produces a warming effect in much of the region above 70 km. TAB

N67-34148# Alaska Univ., College. Geophysical Inst.
A DYNAMICAL MODEL OF AURORAL MORPHOLOGY
R. N. DeRitt and S. I. Akasofu *In* ESRO Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes Aug. 1966 p 125–150 refs (See N67-34141 20-29)
(Grants NsG-201-62; NSF GP-2721)

A dynamical model of auroral morphology was constructed which provided a framework into which many auroral observations can be fitted. The aurora in the portion of the auroral oval centered on the geomagnetic midnight meridian, the auroras occurring on

the day side of the auroral oval are discussed. The polar cap aurora is reviewed as well as the variation in position of the auroral zone. ESRO

N67-34149# University Coll., London (England).
MEASUREMENT OF ELECTRIC FIELDS IN THE IONOSPHERE AND MAGNETOSPHERE
R. L. F. Boyd *In* ESRO Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes Aug. 1966 p 155–166 refs (See N67-34141 20-29)

The problem involved in making measurements of the electric field, either directly by direct measurement of a potential difference constituting the field or indirectly by a study of local motions of energy distributions of low energy ions in the field, is considered. ESRO

N67-34150# Royal Inst. of Tech., Stockholm (Sweden).
THEORY OF ELECTRIC FIELD MEASUREMENTS CONDUCTED IN THE MAGNETOSPHERE WITH ELECTRIC PROBES
U. Fahleson *In* ESRO Auroral and Assoc. Magnetospheric Phenomena of Very High Latitudes Aug. 1966 p 187–206 refs (See N67-34141 20-29)

Among the methods employed to measure electric fields in the magnetosphere, probe measurements seem at present to be best suited. Some of the necessary considerations behind a successful probe experiment are discussed. The dimensions and the shape of the smallest possible probe system capable of performing measurements from which a rough estimate (10–20%) of the net electric field in space can be deduced, are discussed. From discussion of possible errors (due to voltmeter current, to finite probe distance, thermal noise etc.) and from the probe dimensions it is concluded that there should be no great difficulties in making rough measurements of the electric fields in the ionosphere. Using metallized balloons it should be possible to obtain order of magnitude estimates of electric fields out to a distance of several earth radii. ESRO

N67-34176*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC CHART OF THE BRAZILIAN ANOMALY—A VERIFICATION
Joseph C. Cain, Robert A. Langel, and Shirley J. Hendricks Aug. 1967 13 p refs
(NASA-TM-X-55878; X-612-67-373) CFSTI: HC $3.00/MF $0.65 CSCL 08N

Data derived in part from the OGO-2 measurements on the geomagnetic anomaly are described and are compared with the results of Cosmos 26 and 49 measurements. The OGO-2 data was obtained using a least squares technique to fit the potential expansion. Plots of the magnetic field contours are presented, and a table of the computed positions of the minimums are included. Very good agreement was found between the two sets of data and analysis techniques for both the positions of the minimums and the experimental field gradients. N.E.N.

N67-34181# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
CONVECTIVE ELEMENTS Final Report
Apr. 1967 83 p refs
(Grant DA-AMC-36-039-63-G1)
(ECOM-039G1-F; AD-653849) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. DESIGN OF A SIMPLE HEAT FLUX METER J. A. Businger p 2–5 refs (See N67-34182 20-14)

2. ON THE DIRECT DETERMINATION OF THE VERTICAL HEAT FLUX J. A. Businger, M. Miyake, and A. Dyer p 6–10 refs (See N67-34183 20-13)

3. SOME CHARACTERISTICS OF CONCENTRATED CONVECTIVE VORTICES J. A. Turner p 11–26 refs (See N67-34184 20-13)

4. INVESTIGATION OF A PARTICULAR MODE OF INSTABILITY FOR AN IDEALIZED VORTEX MODEL K. H. Bergman p 27–68 refs (See N67-34185 20-12)

N67-34183# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
ON THE DIRECT DETERMINATION OF THE VERTICAL HEAT FLUX
J. A. Businger, M. Miyake, and A. Dyer *In its* Convective Elem. Apr. 1967 p 6–10 refs (See N67-34181 20-13)

Measurements recorded by the Fluxatron, the Evapotron, and the continuous wave sonic anemometer were compared in an effort to assess independent techniques of directly measuring vertical heat flux. All three instruments measure simultaneously the vertical wind component and temperature at almost the same place. Both the Fluxatron and Evapotron perform analog multiplication and integration using signals from transducers directly. The effect of drift is filtered using a band pass filter. The sonic anemometer simultaneously records measurement data on magnetic tape. Heat flux is later computed on an analog or digital computer, which is less direct but requires a minimum of filtering. The three flux meters were mounted on separate poles at equal heights. Net radiation, weather, and soil heat flux measurements were taken to support the meter observations. Results show unsatisfactory agreement between Fluxatron and sonic anemometer measurements, and indicate that Eulerian point observation to obtain heat flux requires very long sampling times before a representative sample for the surrounding area is obtained. E.C.

N67-34184# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
SOME CHARACTERISTICS OF CONCENTRATED CONVECTIVE VORTICES
J. A. Turner *In its* Convective Elem. Apr. 1967 p 11–26 refs (See N67-34181 20-13)

Model configurations for vortex generators are reviewed. A baffle configuration is cited which yielded an extremely stable vortex, even with very small heat input. Tracer techniques were used to study vortex characteristics. As shown in tabular data, extremely large fluctuations in temperature were noted, making mean temperature readings somewhat indefinite. A spherical pendulum technique, consisting of a styrofoam ball suspended on a single nylon fiber, was used to measure tangential velocity. A theoretical explanation is given in which it is shown that the ball will seek the radius of the vortex where the angular velocity corresponds to the natural frequency of the pendulum. Accurate representation of the tangential velocity over a limited portion of the vortex was obtained using several lengths of pendulum suspended at various heights over the plate. Limited field observations of convective vortices are mentioned. Equations are discussed for such phenomena as vortex downdraft, stability of temperature cross sections, and boundary layer heat flux. An IBM 7094 computer program for obtaining solutions to some boundary layer flow integral equations is included. E.C.

N67-34188# Bergen Univ. (Norway). Seismological Observatory.
SITE SELECTION FOR A SEISMIC ARRAY STATION AND CRUSTAL STUDIES IN NORWAY Final Report, 1 Apr. 1965–31 Dec. 1966

Anders Sornes and Markvard A. Sellevoll 21 Feb. 1967 109 p refs
(Contract AF 61(052)-859; ARPA Order 612-1)
(AFOSR-67-1370; AD-653979) CFSTI: HC $3.00/MF $0.65

A study of a possible relocation of the seismic array station LHN (Lillehammer) in south-central Norway is first reported in Part I. One new site is recommended. Part II reports results obtained from three widely separated seismic refraction profiles in Norway and a travel time study for seismic waves in Fennoscandia. The Pn velocities found are very close to 8.20 km/sec. Indications of a phase with velocity of 7.50 km/sec are observed. A phase with a velocity of about 6.60 km/sec is well defined in the seismograms. The amplitude for this phase varies strongly. The velocity for the first direct longitudinal wave varies mostly from 6.00 km/sec to 6.15 km/sec. A crustal thickness from 31 km to 38 km has been determined. Author (TAB)

N67-34197# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
LOW ENERGY ELECTRONS ON A FIELD LINE WITH A POTENTIAL MINIMUM
Joseph M. Grebowsky 20 Apr. 1967 44 p refs
(Contract AF 19(628)-4014; Grant NSF GP-5611)
(SR-296; AFCRL-67-0328; AD-653639) CFSTI: HC $3.00/MF $0.65

Although the component of electric field parallel to the earths magnetic field lines is weak, it is important in considering the motion of low energy charged particles in the tail of the magnetosphere. This electric field is due to a process similar to the thermoelectric effect. At connection of the interplanetary and earth field lines on the dayside there is a minimum of electric potential. Model distribution functions are used to compute the electron density at several points on the line of force as a function of the local potential. The results can be used to determine the potential, when the electron density is known. Author (TAB)

N67-34220 Kiruna Geophysical Observatory (Sweden).
KIRUNA GEOPHYSICAL DATA Data Summary 66/1, Jan.–Mar. 1966
G. Gustafsson and L. Liszka, ed. Mar. 1966 59 p

Geophysical data related to polar upper atmosphere conditions are presented. The data were measured at the Kiruna Geophysical Observatory, Kiruna, Sweden, at the geographic coordinates 67.8°N and 20.4°E and at the geomagnetic coordinates 65.3°N and 115.5°E. Tables for January through March 1966 on geomagnetic K-indices, ionospheric absorption of 27.6 MHz cosmic noise, the visible auroral index, the N–S earth current amplitude activity, and magnetic pulsations from 0.5 to 0.01 Hz, are presented. Graphic data and diagrams for the same period are given for the 1) mean diurnal and day-to-day variation of cosmic noise absorption, 2) mean diurnal variation of oblique VHF auroral echo occurrence, 3) average diurnal and day-to-day variation of the 19.6 kHz transmissions from Rugby. Riometer recordings at 27.6 MHz are reproduced. L.S.

N67-34224*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE RESPONSE OF THE UPPER ATMOSPHERIC TEMPERATURE TO CHANGES IN SOLAR EUV RADIATION AND GEOMAGNETIC ACTIVITY
S. Chandra and B. V. Krishnamurthy 1967 22 p
(NASA-TM-X-60155) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The upper atmospheric neutral temperature derived from satellite drag is analyzed to determine the relative importance of solar EUV and magnetic activity on heating of the upper atmosphere. As the indices of solar EUV radiation, the radio fluxes obtained from ground observations at 200–9400-Mc/s are used. A direct comparison is also made with the EUV flux obtained from the OSO 1 Satellite. As the index of magnetic activity the planetary magnetic index K_p is used. The data were analyzed by separating the long period components of 27 days and above from the short term components by using a 5 day running mean filter. The long term variations in temperature are strongly correlated with the similar variations in the radio flux at 1000–3750 Mc/s, the correlation being maximum at 1000 Mc/s. The short term variations in temperature are strongly related with those in ΣK_p, the daily sum of K_p indices. The correlation between temperature and EUV flux in the short term components is somewhat better. Author

N67-34261# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
ISOSTASY OF ANTARCTICA [IZOSTAZIYA ANTARKTIDY]
S. A. Ushakov and A. I. Frolov Jun. 1967 12 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Geofiz. (Moscow), v. 160, no. 4, 1965 p 819–822
(ACIC-TC-1212; TT-67-62142; AD-653952) CFSTI: HC $3.00/MF $0.65

Because of the complexity of isostatic anomaly computations, the conclusion on the isostatic state of Antarctica was originally drawn by averaged anomalies with a free-air reduction. However, B. A. Andreyev drew the conclusion that at the center of Antarctica one can expect to discover intensive negative isostatic anomalies of the order of 80 mgals. In this article the authors independently and by different methods attempted to find answers to the given conclusions. Author (TAB)

N67-34276 Kiruna Geophysical Observatory (Sweden).
NATURAL ELECTROMAGNETIC FIELDS AND WAVES OVER GEOLOGICAL CONDUCTORS
S. Westerlund Dec. 1966 158 p refs
(KGO-665)

The electric and magnetic properties of the earth's crust and mantle are discussed, and a short survey is given of the characteristics of the natural noise field in the frequency range 10^{-10}–10^{10} Hz. The theory of induction in a flat stratified earth as applied in the magnetotelluric method of geophysical prospecting is reviewed and the application of the magnetotelluric method considering also the extension of inducing fields and inhomogeneity and anisotropy in the earth strata is discussed. The resolving power of the magnetotelluric method is touched upon and examples on experimental results, which have appeared in the literature, are given. The theory of induction in conducting and permeable bodies is exemplified with the case of a sphere and some examples on experimentally found anomalies in the earth's crust and mantle are shown. Author

N67-34278# Aeronautical Chart and Information Center, St. Louis, Mo.
THEORY OF MEASUREMENT OF GRAVITY FROM AIRPLANES WITH THREE ORTHOGONAL SLIDE-WIRE TRANSMITTERS, PART II [TEORIYA IZMERENIYA SILY TYAYHESTI S SAMOLETA TREMYA ORTOGONAL'NYMI STRUNNYMI DATCHIKAMI]
Yu. A. Tarakanov Jun. 1967 29 p refs Transl. into ENGLISH from Fiz. Yemli, no. 10, 1965 p 72–82
(ACIC-TC-1190; TT-67-62155; AD-653961) CFSTI: HC $3.00/MF $0.65

The paper discusses the theory of measurement of gravity from airplanes with three orthogonal slide-wire transmitters. Author (TAB)

N67-34279# Weapons Research Establishment, Salisbury (Australia).
IONOSPHERIC DATA FOR NOVEMBER 1966 FROM SALISBURY, SOUTH AUSTRALIA
Mar. 1967 26 p
(CPD-1966/11(S)) CFSTI: HC $3.00/MF $0.65

Tables are presented of the hourly values of the ionospheric data. The characteristics of the ionosonde are included. N.E.N.

N67-34280* Yale Univ. Observatory, New Haven, Conn.
RADIATIVE EQUILIBRIUM IN AN ATMOSPHERE WITH CONSTANT EINSTEIN ABSORPTION COEFFICIENT
Rupert Wildt and Sandra Schwartz [1966] 76 p refs
(Grant NGR-07-004-029)
(NASA-CR-87417) CSCL 04A

In the classical gray atmosphere, the phenomenological coefficient of absorption that enters Kirchhoff's law is assumed to be independent of the frequency. Strictly, this coefficient is the product of the Einstein coefficient of true absorption and a frequency-dependent correction for induced emission (Rosseland factor). The alternative here examined is to set the Einstein coefficient constant, to incorporate the effects of induced emission into the transfer formalism, and to determine the march of the LTE source function by numerical iteration. This second kind of gray atmosphere differs markedly from the classical one in respect to many physical characteristics and represents, in the conventional terminology, the simplest non-gray problem that is physically realistic. Author

N67-34281# Aeronautical Chart and Information Center, St. Louis. Linguistic Section.
ON THE PROBLEM OF DETERMINING THE DEFLECTION OF THE VERTICAL ON THE BASIS OF MOLODENSKIY'S THEORY [K VOPROSU OB OPREDELENII UKLONENIYE OTVESA NA OSNOVE TEORII MOLODENSKOGO]
V. P. Stoykov Jun. 1967 22 p refs Transl. into ENGLISH from Izv. Vyssh. Uchab. Zaved. Geod. i Aerofotos (Moscow), Iss. 3, 1966 p 75–87
(ACIC-TC-1202; TT-67-62141; AD-653953) CFSTI: HC $3.00/MF $0.65

The article discusses Molodenskiys formula in showing that the value at a point on the earth surface of the derivative with respect to the direction perpendicular to the normal to the reference surface can be obtained. The article also shows that the value of the derivative with respect to the indicated normal can also be obtained on the basis of this formula for the derivation of expressions of proper gravity anomalies. Author (TAB)

N67-34295# University Coll., Nairobi (Kenya). Dept. of Physics.
IONOSPHERIC RESEARCH USING SATELLITES Summary Report, 17 Nov. 1965–17 Nov. 1966
A. N. Hunter and A. R. Webster 21 Nov. 1966 44 p refs
(Contract AF 61(052)-909)
(SR-1; AFCRL-67-0284; AD-653950) CFSTI: HC $3.00/MF $0.65

Results are presented for total content at Nairobi since October 1964, and for Addis Ababa and Dar es Salaam since June 1966. Latitude variation of total content is being studied using three spaced receiving stations on similar longitudes; preliminary results are presented for the period July/August 1966. Study of irregularities has been commenced using scintillations of transmissions from B.E.-B and B.E.-C and the heights of these irregularities will be determined from transmissions from B.E.-B using spaced aerials. One of us (A.R.Webster) has made a study of geometric errors in Faraday reduction. Other work includes the determination of ionospheric parameters by means of an ionosonde, investigations on the shape, size and speed of irregularities, by a spaced aerial technique, and recording of the variations of the earths magnetic field. Future plans include continuation of the above work, development of automatic Faraday null reading equipment and possibly the addition of one or two other stations for the study of the latitude variation of scintillations and total content. Author (TAB)

N67-34301* National Aeronautics and Space Administration, Washington, D. C.
DETERMINATION OF THE EARTH'S SHAPE [LA DETERMINATION DE LA FORME DE LA TERRE]
H. M. Dufour Aug. 1967 30 p refs Transl. into ENGLISH of a Paper Presented at the Meeting of the Natl. Center of Space Studies on Dyn. Methods of Geodesy by Means of Satellites, Paris, 1967
(NASA-TT-F-11191) CSCL 08E

The principle of various methods for determining the shape and dimensions of the earth and the relations for the astrogeodetic geoid are discussed, with a historical review and brief data survey over modern satellite measurements. Purely geometric, classical geodetic, astrogeodetic, and gravimetric methods are described, with formulas for changing from Cartesian coordinates to ellipsoidal coordinates, so as to obtain reference points for a unique system based on an ellipsoid of revolution, either of the elongated (Cassini) or oblate (Newton) type. Author

N67-34331# RAND Corp., Santa Monica, Calif.
APPROXIMATION OF THE SINGLE LINE DURING THE TRANSFER OF RADIANT ENERGY IN THE UPPER ATMOSPHERE
G. M. Shved May 1967 7 p refs
(P-3595; AD-653935) CFSTI: HC $3.00/MF $0.65

The author considers values of the frequency interval about the line center in which the approximation of the isolated line is valid for radiative transfer in the mesosphere and upper stratosphere. The regions of validity for this approximation are estimated in the case of the 15 micron CO2 band. TAB

N67-34340# General Electric Co., Philadelphia, Pa. Missile and Space Div.
THE ROLE OF METASTABLE, NEUTRAL ELECTRONICALLY EXCITED SPECIES IN ATMOSPHERIC DEIONIZATION
R. H. Kummler and M. H. Bortner May 1967 92 p refs
(R67SD20; AD-653516) CFSTI: HC $3.00/MF $0.65

The importance of metastable neutral electronically excited species to deionization in the post burst period is considered. Energy levels, lifetimes, production sources, reactions and depletion sinks for excited states of the important atmospheric constituents, N2, O2, O and N are discussed, and extant data on each is tabulated along with some data on minor species. Hypotheses drawn from examination of these tables are tested in an expanded Keneshea Code for numerical integration of the deionization equations. As a result of these calculations, it appears as though the deexcitation detachment reaction of O2((1)delta-g) with O2(-) is the most important detachment process at altitudes below 70 km, if its rate constant is of the same order as that for associative detachment reactions. Author (TAB)

N67-34361 Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, No. 159
1 Jul. 1967 102 p refs
(JPRS-41659; TT-61-11147-159) CFSTI: $3.00

Both abstracts and full-text translations are presented on Soviet open literature research in the fields of astronomy, meteorology, oceanography, terrestrial geophysics, and space sciences. Some

topics treated are meteorological experiments on satellites, scientific instrumentation, theory of ocean currents, lunar surface, earth crust, aerial photography, and trajectory studies. Some short newspaper articles are also included. R.U.

N67-34362 Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, No. 162
16 Aug. 1967 147 p refs
(JPRS-42248; TT-61-11147-162) CFSTI: $3.00

Soviet open literature research in the fields of meteorology, oceanography, terrestrial geophysics, and space sciences are presented both as abstracts and full-text translations. Areas of interest developed include: radio galaxy emission, weather observation, satellite sounding, cloud seeding, ice-forming aerosols, wind velocity measurement, underwater observation chamber, sedimentation mechanism in the ocean, marine gravimeter, and the control of an artificial satellite in flight. R.U.

N67-34370 Joint Publications Research Service, Washington, D. C.
SOVIET COMMITTEE FOR ANTARCTIC RESEARCH REPORTS ON RECENT WORK
28 Jun. 1967 117 p refs Transl. into ENGLISH from Antarkt.: Dokl. Kommissii Moscow, Nauka Publishing House, 1966
(JPRS-41596; TT-67-32229) CFSTI: $3.00

CONTENTS:

1. TEN YEARS IN ANTARCTICA Ye. I. Tolstikov p 1–15 (See N67-34371 20-13)

2. SOME INTERNATIONAL QUESTIONS OF SCIENTIFIC COOPERATION IN THE ANTARCTIC V. I. Ptitsyn p 16–112 refs (See N67-34372 20-13)

N67-34371 Joint Publications Research Service, Washington, D. C.
TEN YEARS IN ANTARCTICA
Ye. I. Tolstikov *In its* Soviet Comm. for Antarctic Res. Rept. on Recent Work 28 Jun. 1967 p 1–15 (See N67-34370 20-13)

Summarized are results of Soviet studies of the Antarctic which were conducted during the period 1956 to 1966. S.C.W.

N67-34372 Joint Publications Research Service, Washington, D. C.
SOME INTERNATIONAL QUESTIONS OF SCIENTIFIC COOPERATION IN THE ANTARCTIC
V. I. Ptitsyn *In its* Soviet Comm. for Antarctic Res. Rept. on Recent Work 28 Jun. 1967 p 16–112 refs (See N67-34370 20-13)

The significance of Antarctica as the site of scientific research and meteorological observations during the International Geophysical Year is outlined. The history of scientific exploration is summarized very briefly and the regional character of the Antarctic Treaty is noted. R.U.

N67-34410 Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE
1 Aug. 1967 73 p refs
(JPRS-42041; TT-61-11147-161) CFSTI: $3.00

Abstracts and bibliographic information concerning astronomy, meteorology, oceanography, terrestrial geophysics, upper atmospherics, and other miscellaneous topics, gathered from recent publications of Sino-Soviet Bloc countries, are reported. Information covering 1) stellar structure, 2) interstellar space radio emissions, 3) solar spectrum, 4) brightness in comets, 5) meteor showers, 6) weather conditions, 7) waves and tides, 8) seismology, 9) satellite measurements of the upper atmosphere, and other pertinent investigations, is presented. L.S.

N67-34416# Ohio State Univ. Research Foundation, Columbus.
PROPOSED ESTABLISHMENT OF A FIRST-ORDER HEIGHT SYSTEM IN THE U.S.A. Interim Report, Supplement
Edward J. Krakiwsky Sep. 1966 86 p refs
(Contract DA-44-009-AMC-507(X))
(Rept.-72; IR-5, Suppl.; AD-653778) CFSTI: HC $3.00/MF $0.65

The various types of heights and their numerous methods of computation are presented along with a summary and discussion. Based on theoretical and practical considerations, conclusions are drawn as to which height (along with its corresponding method of computation) is best suited for a specific purpose. Author (TAB)

N67-34418# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
ATMOSPHERIC OZONE INVESTIGATIONS AT BARROW, ALASKA, DURING 1965 Scientific Report
John J. Kelley, Jr. Jun. 1967 102 p refs
(Contract Nonr-477(24))
(AD-653745) CFSTI: HC $3.00/MF $0.65

The results of the measurements of ozone in air at Barrow, Alaska, are presented. The theory of operation of the microcoulomb analyzer, and the methods of calculations and calibrations are discussed. The average daily and hourly concentrations of ozone in the atmosphere near the ground surface are tabulated for the year 1965. The results of the analysis of ozone measured continuously from light aircraft along several transects in Northern Alaska are given. Author (TAB)

N67-34426# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
THE DEPENDENCE OF THE RICHARDSON NUMBER ON SCALE LENGTH
Elmar R. Reiter and Peter F. Lester Jul. 1967 43 p refs *Its* Atmospheric Sci. Paper No. 111
(Grant WBG-59) CFSTI: HC $3.00/MF $0.65

It is shown theoretically that the Richardson number depends on the thickness L of the layer over which it is computed. The relationship has the form $Ri \propto L^p$ where $0<p<4/3$. Experimentally, FPS-16 radar wind measurements and detailed radiosonde observations show that p may also be a function of L and that with actual wind profiles even negative values of p may be encountered. From this study it appears that until accurate observations of the state of the atmospheric mesostructure are available, no unique correlation between Ri and clear air turbulence should be expected to exist Author

N67-34427# California Univ., Livermore. Lawrence Radiation Lab.
EFFECT OF THERMAL HISTORY ON COMPOSITION CHANGES AND HARDNESS IN A MARAGING STEEL
Alfred Goldberg 6 Mar. 1967 35 p refs
(Contract W-7405-ENG-48)
(UCRL-50207) CFSTI: HC $3.00/MF $0.65

The influence of thermal history on the transformation behavior in a 300-grade 18%-Ni maraging steel was investigated. An important aspect of this study, which is based mainly on dilatometry, was to show that extensive microsegregation can develop in a maraging steel subjected to thermal cycling. The dilatometric studies were supplemented by microscopy, X-ray diffraction, hardness

measurements, and magnetic permeability measurements. The dilatometric curves suggest that, as a result of prior thermal treatment, large changes in the temperature ranges of both the A (austenite) → M (martensite) and M → A transformations can occur. These changes are due to the microsegregation that had developed during the prior heating. This microsegregation largely originates during the process of precipitation that precedes the M → A reversion. On heating, precipitates form that are rich in elements which, when dissolved in A, depress the M_s (martensite-start temperature). Author (NSA)

N67-34434 Joint Publications Research Service, Washington, D. C.
TEN YEARS OF SOVIET ANTARCTIC RESEARCH
A. G. Chernov 5 Jul. 1967 60 p Transl. into ENGLISH of the Title "Desyat' Let Sovetskikh Issledovaniy v Antarktide" Moscow, "Znaniya" Publishing House, 1966 p 1–56
(JPRS-41701; TT-67-32333) CFSTI: HC $3.00

A full-text translation is presented on ten years of Soviet Antarctic research. A brief historical background is accompanied by geological studies and reports of polar expeditions. R.U.

N67-34435 Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO-SOUNDING: FREIBURG, URSI-CODE 131 [IONOSPHAREN-DATEN VERTIKAL-ECHO-LOTUNG FREIBURG URSI-CODE 131]
Jun. 1967 45 p In GERMAN and ENGLISH
(Rept.-252-F)

Tabulations are presented on ionosphere data, vertical-echo-soundings. It is accompanied by ionospheric characteristics and punchcard-codes. R.U.

N67-34448 Defence Research Telecommunications Establishment, Ottawa (Ontario).
ALOUETTE I IONOSPHERIC DATA N(h), VOLUME 4, NO. 1
1 Jun. 1967 380 p

Electron number density profiles for selected groups of ionograms obtained from the Alouette I topside sounder satellite are tabulated. The profiles are listed in the order in which the ionograms were recorded. An explanation of the tables and symbols used is given. R.N.A.

N67-34454# Kakioka Magnetic Observatory (Japan).
REPORT OF THE GEOMAGNETIC AND GEOELECTRIC OBSERVATIONS, 1965 (RAPID VARIATIONS)
1966 128 p refs
(Rept.-6) CFSTI: HC $3.00/MF $0.65

Tabular data arranged in chronological order are presented based on observations of magnetic storms, sudden impulses, bays, solar flare effects, and pulsations. Selected examples of rapid-run induction magnetograms and rapid-run tellurigrams are also given. Instrument sensitivity data for the rapid-run induction magnetograms and tellurigrams are summarized. E.C.

N67-34465 Ludwig-Maximilians-Universitat, Munich (West Germany).
MEASUREMENT OF THE TOTAL INTENSITY (T) OF THE GEOMAGNETIC FIELD IN THE RIES AND ITS VICINITY, 1962–1965. MEASUREMENT OF A GEOMAGNETIC ANOMALY Z NEAR WOERNITZOSTHEIM [VERMESSUNG DER TOTALINTENSITAET (T) DES ERDMAGNETISCHEN FELDS IM RIES UND SEINER UMGEBUNG 1962–1965. VERMSSSUNG EINER ERDMAGNETISCHEN ANOMALIE Z BEI WOERNITZOSTHEIM]
G. Anganheister, J. Pohl, and A. Hahn 1966 55 p refs In GERMAN *Its* Ser. B No. 4

The total intensity measurements were made with a proton magnetometer along eight profiles and at 1396 points throughout the area. At least four points were measured at each station. Data were also collected for an isanomaly plan. Temporal variations for the geomagnetic field were derived from the registrations of a geophysical observatory located at distances between 70 and 135 km from the measuring points. The data that were obtained are listed in tables. The second part of this paper lists the measurements and drillings to identify the strongest known anomaly in the Ries area. This negative anomaly is nearly circular, measures several 10 m in diameter, and has a minimum value of −600 γ. Profile charts, drilling points, and isanomaly plans of this area are presented. Transl. by K.W.

N67-34466 Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO-SOUNDING: FREIBURG URSI-CODE 131, JANUARY–MARCH 1967 [IONOSPHAEREN-DATEN VERTIKAL-ECHO-LOTUNG: FREIBURG URSI-CODE 131, JANUAR–MAERZ 1967]
Mar. 1967 122 p In GERMAN and ENGLISH
(Rept.-247-F; Rept.-248-F; Rept.-249-F)

Tabulations are presented of ionospheric data gathered at Freiburg. Symbols as recommended by the URSI Handbook of Ionogram Interpretation and Reduction of the WWSC are provided to interpret data on vertical echo soundings. R.U.

N67-34517# Sheffield Univ. (England). Dept. of Applied Mathematics and Computing Science.
AN IDEALIZED PROBLEM WITH F2-LAYER APPLICATIONS
W. M. Pickering [1967] 27 p refs Submitted for publication
(Grant AF-EOAR-64-74)
(SR-8; AFCRL-67-0174; AD-653648) CFSTI: HC $3.00/MF $0.65

An idealized problem is solved which illustrates the coupling between neutral air motion and the transport of plasma in a model F2 layer. The magnetic field lines are assumed to be horizontal and the effects of both vertically upwards and vertically downwards Hall drifts are considered. Very slow circulating motion of the neutral air is assumed to take place in a vertical plane parallel to the magnetic field lines. This motion is assumed to be coupled with the diffusive and Hall motions of the plasma. It is shown that if only the production and loss functions for electrons are known a non-linear diffusion equation is produced. Author (TAB)

N67-34570# Technical Operations Research, Burlington, Mass.
DEVELOPMENT OF AN IMPROVED LAND-SURFACE FALLOUT MODEL. PART I: ATMOSPHERIC TRANSPORT Final Report, 31 Mar. 1965–31 Jan. 1967
T. W. Schwenke, I. Kohlberg, H. G. Norment, and W. Y. G. Ing
Feb. 1967 320 p refs
(Contract DA-28-043-AMC-01309(E))
(TO-B-66-80; ECOM-01309-F; AD-653633) CFSTI: HC $3.00/MF $0.65

A collection of models developed to simulate atmospheric transport of local fallout from nuclear detonations is described. These models comprise the Transport Module of the Department of Defense Land Fallout Prediction System (acronym DELFIC). Details of the physical bases of the models as well as the Transport Module computer programs are presented. The programs provide for temporal and three-dimensional spatial variation of the wind field. Wind-field construction from input data can be accomplished by one of several preprogrammed methods that may be selected on the basis of the type and quantity of available data. Submodels for special local circulation systems can be superposed on the macrowind system. A capability to simulate highly variable topography is included. The computer programs are essentially open ended with regard to capacity for particle, wind field, and topography data. TAB

N67-34574# Harvard Univ., Cambridge, Mass. Lab. for Computer Graphics.
CONCEPTS AND APPLICATIONS—SPATIAL ORDER
William Warntz and Michael Woldenberg 16 May 1967 195 p refs *Its* Harvard Papers in Theoret. Geography, "Geography and the Properties of Surfaces" Ser., No. 1
(Contract N00014-66-00121)
(AD-653464) CFSTI: HC $3.00/MF $0.65

Contents: Part I: Demonstration of a general property of closed surfaces; An additional graphical portrayal; Contour lines; Varying the contour interval and singular points; Singular points and lines; Hill and dales and territories; Surfaces and the mathematical functions of three variables; Multiple passes and pales; Hill, dales, territories and general topological considerations; The indicatrix; Surfaces, flows, and dimensions; Part II: Exponential and allometric growth as most probable states for open systems; On the ordering of tree-like course lines on surfaces: The example of the river; On the ordering of tree-like course lines on surfaces: The example of mountain glaciers; On the ordering of points in areas: The example of a central place system for human activities; On the similarities and differences between tree-like and web-like open systems; A theory of geomorphic cyclical evolution based on the graded profile; The potential of population surface and flows; Fronts in the atmosphere and hydrosphere and other discontinuities. TAB

N67-34637# Kiruna Geophysical Observatory (Sweden).
ON THE AMPLITUDE DISTRIBUTION OF SCINTILLATING RADIO SIGNALS FROM ARTIFICIAL SATELLITES
A. W. Wernik and L. Liszka (Polish Acad. of Sci., Warsaw) Jan. 1967 20 p refs
(Rept.-671)

Twenty-two amplitude distributions of scintillating satellite signals are analysed. Difference between observed and theoretical Rice distributions are explained by the existence of correlation between orthogonal components of the electromagnetic field vector of the scattered wave. Author

N67-34656 National Physical Lab., New Delhi (India). Radio Propagation Unit.
SOLAR AND GEOPHYSICAL DATA, PART 2
Mar. 1967 14 p Prepared for Radio Res. Comm., Council of Sci. and Ind. Res.
(RRC-A141, Pt. 2)

Tabulated data from four Indian stations are presented from observations during February 1967. The data are on predicted and observed sunspots, solar flux, solar flares and their ionospheric effects, and magnetic storms. Also given are diagrams of sudden ionospheric disturbances. K.W.

N67-34667*# California Univ., Berkeley. Space Sciences Lab.
STUDIES OF THE AURORAL SUBSTORM. III: CONCEPT OF THE MAGNETOSPHERIC SUBSTORM AND ITS RELATION TO ELECTRON PRECIPITATION AND MICROPULSATIONS
F. V. Coroniti, R. L. Mc Pherron, and G. K. Parks May 1967 26 p refs
(Grants NsG-243; NsG-387; NFG GP-5583; NFG GP-5331; NSF GA-734)
(NASA-CR-87824) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The concept of the auroral substorm is reviewed in terms of recent satellite measurements of the magnetospheric effects of a substorm, and a more general and inclusive terminology, the magnetospheric substorm is suggested. In support of this suggestion it is shown that the various forms of geomagnetic micropulsations and energetic electron precipitation which were previously discussed occur at their respective local times during a substorm. Balloon X-ray and micropulsation data, as well as riometer absorption, earth currents, and standard magnetograms from several auroral zone stations have been used. Author

N67-34693 National Oceanographic Data Center, Washington, D. C.
COMPUTER PROGRAMS IN OCEANOGRAPHY
Cloyd H. Dinger, comp. 1967 100 p refs *Its* First Revision (C-5, Rev. 1) Available from Naval Oceanog. Office, Washington, D. C.: $1.00

A catalog of computer programs related to the field of oceanography is presented. The programs are listed according to selected subject headings. Under each heading or subheading, the programs are listed alphabetically by program language, then by computer. Each entry contains the program title, the program language, the computer it is written for, whether the program is on file at the National Oceanographic Data Center, an abstract of the program, and the name and address of the person to contact for further information. Indices are included which list the programs by institution, language, and computer. Other known catalogs of computer programs pertaining to disciplines related to oceanography are also given. R.N.A.

N67-34721 Southampton Univ. (England). Inst. of Sound and Vibration Research.
SUMMARIES OF PAPERS OF THE EUROMECH COLLOQUIUM—THE STRUCTURE OF TURBULENCE
Mar. 1967 52 p refs Colloq. held 29–31 Mar. 1967

Abstracts and summaries of forty papers on the structure of turbulence are presented among which are cited studies of large scale motion in a turbulent boundary layer; the existence of universal velocity distributions in an oscillatory, turbulent boundary layer; incompressible turbulent boundary layers in channel flow; a new physical model of wall turbulence; direct measurements of surface shear with fluid injection; the influence of shear flows in a stratified contaminant; local pressure fields of jets; flow excited vibrations and radiated noise; sound generation by a dusty gas; mixing of hot and cold air streams in a pipe; the stability of the turbulent mean profile; spectra of grid turbulence; the response of initially anisotropic turbulence to distortion; computer studies of vortex models to represent turbulent fluid flow; and turbulent or eddy viscosity. S.C.W.

N67-34732# Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO-SOUNDING: FREIBURG, USRI-CODE 131 [IONOSPHAEREN-DATEN VERTIKAL-ECHO-LOTUNG: FREIBURG URSI-CODE 13]
Mar. 1967 44 p In GERMAN and ENGLISH
(Rept.-251-F) CFSTI: HC $3.00/MF $0.65

Ionospheric data obtained by vertical echo soundings over Freiburg, Germany, are presented. Tabular data are provided for the period March 1967. R.L.

N67-34744 Royal Aircraft Establishment, Farnborough (England).
MEASUREMENTS OF THE TEMPERATURE OF THE EARTH'S SURFACE FROM AIRCRAFT [MESSUNGEN DER BODENOBERFLACHENTEMPERATUR VON LUFTFAHRZEUGEN AUS]
Dieter Lorenz Jun. 1967 79 p refs Transl. into ENGLISH from the German Rept. T-270-1-203, Apr. 1966
(RAE-LIB-TRANS-1229; T-270-1-203)

Tests were made of three models of infrared radiometers carried in aircraft to determine the errors involved in measuring surface temperature with them. For water, errors appeared to be less than 1°C. Considerable differences between surface temperatures of land and the air temperature were obtained and the effects of vegetation were examined. The influences of the air layer below the aircraft, of the inclination of the scanning beam and of the solar radiation were also studied. Author

N67-34777*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PHYSICS
In its Space Programs Sum. No. 37-45, Vol. IV 30 Jun. 1967 p 251-258 refs (See N67-34761 20-30)

A proposed model of polar substorms, which is essentially a flow sequence, is discussed. It is shown that the model accounts in some detail for the auroral effects; the auroral forms; the auroral bulge shape, growth, and subsidence rates; the velocity of auroral patches; the auroral particle energy; and the total energy of the substorm. The use of a dynamitron accelerator as a source of thermal neutrons is also discussed. The three elements for producing thermal neutrons are cited as the accelerator, the target, and the moderator. The dynamitron accelerates deuterons to an energy of 2.5 MeV, with currents up to 1.5 mA. Tests were performed to determine the yield of thermal neutrons and their angular distribution. Graphs depict the results in terms of the optimum flux of thermal neutrons as a function of the energy of the deuterium ions, and the contours of thermal neutron flux as a function of position in the moderator. Equations are derived to show the application of the algebra of Fermi-Dirac operators to many-body problems. M.G.J.

N67-34814 Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 160
17 Jul. 1967 121 p refs
(JPRS-41856; TT-61-11147-160) CFSTI: $3.00

Recent Soviet-Bloc publications dealing with astronomy, meteorology, oceanography, terrestrial geophysics, the upper atmosphere, and space research are presented in the form of abstracts, summaries, and complete articles. Complete bibliographic information accompanies each entry. R.N.A.

N67-34849# Negev Inst. for Arid Zone Research, Beersheba (Israel).
HISTORICAL EVIDENCE OF SEA-LEVEL CHANGE AND ITS RELATION TO POLAR ALBEDO
M. R. Bloch *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 179-196 refs (See N67-34841 20-20)

The eustatic changes of the ocean level during the last 5000 years are discussed; the history of the salt industry is especially useful for this purpose because of its sensitivity to sea-level changes. The maxima of sea-level height in the beginning of the first millenium B.C. and the first millenium A.D. are hypothetically connected with ash layers found by Crary, et al. (1962) in their Little America ice core, and are ascribed to these periods. It is hypothesized that discoloration of snow in the Antarctic has led to widespread melting of the southern ice cap in historic times and to consequently small (±1.5 m) eustatic changes of sea level. It is also stated that any discoloration of the polar ice masses should raise the polar temperatures and make the polar heat sinks shallower than they normally are in their respective summers. The hypothesis is expressed that a discoloration of the Antarctic in 1884 (Krakatoa) caused the southern heat sink to become shallower than normal for several years. Author

N67-34850# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
CALCULATING THERMAL REGIME AND MASS BUDGET OF SEA ICE
N. Untersteiner *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 203-213 refs *Its* Contrib. 120 (See N67-34841 20-20)

A mathematical model for predicting thickness and temperature of sea ice is described. It consists of the equations of heat conduction for both snow and ice, with variable thermal constants and a term representing internal heating by radiation. The boundary conditions at the interfaces with the atmosphere and the ocean are given in the form of heat budget equations. The fluxes of radiative, latent, and sensible heat are treated as independent parameters (except for the infrared emission from the surface, which is calculated). This model is being programmed for long-term (several years) integration with various combinations of heat fluxes in the atmospheric and oceanic boundary layers, and should provide some insight into the relation of climatic change to ice production, decay, and equilibrium thickness. Author

N67-34851# Naval Oceanographic Office, Washington, D. C.
COMMENTS ON THE MASS BUDGET OF ARCTIC PACK ICE
W. I. Wittmann and J. J. Schule, Jr. *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 215-247 refs (See N67-34841 20-20)

A geometrical model based on empirical observations of under-ice, surface, and subsurface features is offered to permit computations of the volume of sea ice contributed by pressure ice. This model suggests that 1:3.3 is a realistic ratio between the above-water and underwater portions of an ice pressure ridge. Seasonal and spatial data from two years of aerial surveys on the frequency and height of ridges are presented, showing maximal values in winter near the North American coastlines. Similar data are presented on ice concentrations, stage of ice development, and the distribution of open and refrozen water throughout the Arctic Basin. Extensive submarine echo sounding data on the frequency of ice of various thicknesses corroborate the existence of larger amounts of open water—15 percent more in summer—than previously estimated over large portions of the Arctic Basin. Author

N67-34856# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
TRANFER OF MOMENTUM AND HEAT IN THE PLANETARY BOUNDARY LAYER
J. A. Businger *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 305-332 refs *Its* Contrib. 119 (See N67-34841 20-20)

Special solutions formulated for momentum transfer in the steady neutral boundary layer were generalized to the steady diabatic case using a new set of asymptotic equations in the surface layer. It appears that the boundary layer has a more or less bimodal structure. It is either stable or unstable, and the neutral case is rather rarely developed. The neutral case is not a good approximation of either the stable or the unstable case. The interaction between momentum and heat transfer requires simultaneous solution of both aspects of the boundary layer. With this in mind, the dissimilarity between the two fluxes was investigated for the unstable case by using simple models of convective elements. It is concluded that the fluxes are similar when the eddies are spherical, and the ratio of eddy transfer coefficients K_H/K_M will be close to one. For cyclindrical eddies (a simplification of the convective plume), K_H/K_M is found to be a function of stability with a maximum of about 2 for $Z/L \cong 1$. The nonsteady character of the stable boundary layer is qualitatively discussed. Author

N67-34857# Main Geophysical Observatory, Leningrad (USSR).
APPLICATION OF NATURAL ORTHOGONAL FUNCTIONS TO ATMOSPHERIC DYNAMICS AND THERMAL REGIME STUDIES
M. I. Yudin *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 345-368 refs (See N67-34841 20-20)

An optimum method of statistical prediction is applied to the vertical structure of the atmosphere, and it is shown that two or three modes (or terms in the empirical function series) permit a satisfactory representation of the vertical temperature (and geopotential) structure. These modes express the bulk of the observed vertical variation, and are shown to be statistically stable and largely independent of geographic location. The corresponding representation of the horizontal variation in terms of empirical orthogonal functions requires many synoptic observations and should ideally be performed for the entire global atmosphere. On the basis of limited data, however, the first mode (relative to the fundamental or climatic mean) of the surface and 500-mb pressure show large amplitude variations in the area of Greenland and the nearby Arctic. This evidence suggests the importance of this region in the over-all behavior of the atmosphere. Author

N67-34858# California Univ., Livermore. Lawrence Radiation Lab.
NUMERICAL SIMULATION OF THE EARTH'S ATMOSPHERE
C. E. Leith *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 371–400 refs Repr. from Methods in Computational Phys., Appl. in Hydrodyn., New York, Academic Press, v. 4, 1965 - p 1–27 Prepared for AEC (See N67-34841 20-20)

The behavior of the earth's atmosphere has been simulated by a six-layer numerical model that integrates the appropriate primitive equations of hydrodynamics, thermodynamics, and water vapor conservation. The sources of energy computed in the model are those due to incoming solar radiation, latent heat release, and convective heating from the earth's surface. Outgoing terrestrial radiation computed by radiation transport equations serves as an energy sink. The method of fractional time steps has been used to combine simple algorithms into an accurate and stable numerical scheme. The problem of statistically treating the vertical transport of heat, water vapor, and momentum by small-scale convective processes is not yet satisfactorily solved. Many months of simulation have disclosed such characteristic features as a jet stream, trade winds, and Icelandic and Aleutian lows. The creation, motion, and decay of storms also appear. Author

N67-34859# National Center for Atmospheric Research, Boulder, Colo.
A REPORT ON THE GENERAL CIRCULATION EXPERIMENTS AT NCAR
A. Kasahara and W. M. Washington *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 401–411 refs (See N67-34841 20-20)

The general circulation model of the atmosphere uses the z-coordinate system rather than the more customary pressure or sigma systems. Preliminary results from the model indicate that it is capable of generating typical weather patterns if there is sufficient horizontal resolution. Author

N67-34863# Washington Univ., Seattle. Dept. of Oceanography.
PRODUCTION OF SUPERCOOLED WATER DURING SEA ICE FORMATION
L. K. Coachman *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 497–529 refs *Its* Contrib. 383 (See N67-34841 20-20)

A model is proposed to explain the observed features of the oceanic regime of the surface layer of the Arctic Ocean in winter elucidated by detailed station data from ice station Arlis-I. Leads in the ice cover lose heat at a rapid rate, and a local vertical circulation is estsblished at the onset of cold air temperatures in fall. Sinking occurs under areas of open water and a compensating upward advection under the ice. Mathematical formulations based on the conservation of mass and energy, and utilization of data from Arlis-I and from literature sources, allow estimates of the rate of ice growth on open water, convection velocities, and the eddy conductivity of the Atlantic layer. Author

N67-34864# Washington Univ., Seattle. Dept. of Oceanography.
LONG-PERIOD TIME-DEPENDENT MOTION IN A POLAR OCEAN
H. G. Farmer *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 531–548 refs *Its* Contrib. 384 (See N67-34841 20-20)

The factors affecting quasi-geostrophic planetary waves in a polar ocean are briefly reviewed. The analytical solution is known for the wave motion in an ocean of constant depth and bounded by a circle of colatitude. This wave motion is shown to be significantly altered by a small asymmetrical change in the lateral boundary shape. Simple colatitudinal changes in depth are introduced; they are important in determining the wave period and direction of propagation, but longitudinal changes in depth cannot be accounted for as yet. The wave motion is rapidly damped through interaction with the Ekman boundary layers. The analytical solutions are thus only crude approximations for an ocean comparable in shape to the Arctic Ocean. The study of these planetary waves in a laboratory model is discussed, and it is demonstrated through solutions for a rotating cylindrical tank of water that practical laboratory operating conditions can be achieved. Author

N67-34875 Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA: SCIENCE AND TECHNOLOGY NO. 387. DISTRIBUTION OF PRECIPITABLE WATER OVER CHINA
Szu-Chung Cheng and Te-ch'ing Yang 17 Jul. 1967 23 p refs Transl. into ENGLISH from Ti-Li Hsueh-Pao (Peking), v. 28, no. 2, Jun. 1962 p 124–136
(JPRS-41-850; T-67-32482) CFSTI: $3.00

An analysis of data on the global distribution of precipitable water and the characteristics of East Asia circulation is presented. Utilized were records of monthly averages obtained by sounding stations from the time of liberation to 1959. These studies indicate that: (1) The annual distribution of precipitable water over China decreases from southeast toward northwest and is similar to the pattern of distribution of annual precipitation. (2) The water vapor content in eastern regions of China is particularly high, the latitude departure being positive. (3) The north to south gradient of water vapor content in the eastern regions of China is larger in the summer than in winter. (4) The highest water vapor content in the summer occurs in Central China in the form of a closed center. (5) The monthly mean water vapor content is highest in June in the regions of Kwangtung, Kwangsi, Fukien, and southern Hunan and Kiangsi. (6) A large topographical swelling has many effects on the distribution of precipitable water. (7) Precipitation is concentrated in the summer in China. S.C.W.

N67-34928# Kyoto Univ. (Japan).
REPORT ON AEROMAGNETIC SURVEY IN JAPAN
1966 250 p refs

An aeromagnetic survey was made of the Japanese Islands and their neighboring seas. The surveying instruments and the methods of data reduction are described. Magnetic charts showing the tracks of the aeromagnetic surveys and the geomagnetic elements are given along with tabulated data on the geomagnetic elements with reference to latitude, longitude, altitude, data, and time. R.N.A.

N67-34959# Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO-SOUNDING: FREIBURG, URSI-CODE 131 [IONOSPHAEREN-DATEN, VERTIKAL-ECHO-LOTUNG: FREIBURG, URSI-CODE 131]
Apr. 1967 44 p In GERMAN and ENGLISH
(Rept.-250-F) CFSTI: HC $3.00/MF $0.65

Ionospheric characteristic data and punch card codes from vertical echo soundings over Freiburg, Germany are presented. Wave frequencies represent the F_2-, F_1-, and the E-layer reflectance measurements; tabulation sheets contain the punch card-codes of the observed characteristic and the month and year of the observation. R.LI.

N67-34964# Ohio State Univ. Research Foundation, Columbus.
GEODETIC CONTROL WITHOUT TRIANGULATION, TRILATERATION, OR GRAVITY DATA AND GRAVIMETRIC REDUCTION OF LEVELLING Interim Technical Report, Aug. 1965–Feb. 1966
Ivan I. Mueller, Edward J. Krakinsky, and Hans D. Preuss Mar. 1966 12 p
(Contract DA-44-009-AMC-507(X))
(ITR-4; AD-653775) CFSTI: HC $3.00/MF $0.65

The report shows the progress made during the months of August 1965 through February 1966, on Tasks No. 1 and No. 2 of the contract. The work on Task No. 1 is progressing satisfactorily. Local tests on the newly arrived torsion balance are in progress. Preparations are being made for the summer field work. The work on Task No. 2 is practically finished. The last part of the final report on this item is being prepared, and will be submitted about June 1, 1966. Author (TAB)

N67-34965# Ohio State Univ. Research Foundation, Columbus.
GEODETIC CONTROL WITHOUT TRIANGULATION, TRILATERATION, OR GRAVITY DATA AND GRAVIMETRIC REDUCTION OF LEVELLING Interim Technical Report, Mar.–Aug. 1966
Ivan I. Mueller and John Badekas Sep. 1966 9 p
(Contract DA-44-009-AMC-507(X))
(ITR-5; AD-653776) CFSTI: HC $3.00/MF $0.65

The report presents programs in accomplishing the following: To develop a method that establishes geodetic control within a limited area from astronomic observations by removing the deflections of the vertical directly obtained from torsion balance measurements at the station; and to develop a reduction method best suited for the United States which would substitute the presently used method based on the normal gravity field. TAB

N67-34989# RAND Corp., Santa Monica, Calif.
METHOD OF COMPUTING THE DEVIATION FROM KIRCHHOFF'S LAW IN THE MESOSPHERE FOR THE TRANSFER OF RADIATION IN THE 15-MICRON BAND OF CARBON DIOXIDE
G. M. Shved May 1967 24 p refs
(P-3597; AD-653933) CFSTI: HC $3.00/MF $0.65

The ideal structure of the absorption band, as used by Curtis and Goody in the calculation of the radiative heating due to the 15 micron CO2 band, may result in large errors. Accurate calculations require a knowledge of the real structure of the band as well as the replacement of the usual relaxation equation by the system of gas-kinetic equations. The probabilities of nonelastic collisions, taking into account Fermi resonance, are computed. The vibrational relaxation time of CO2 in dry air at 200 degrees K and 1 atm pressure is expected to fall within the interval 2--20 x 10 to the -6th power sec. The contribution of water vapor to the relaxation time of CO2 is discussed. Author (TAB)

N67-35073# Adelaide Univ. (Australia). Dept. of Physics.
DETERMINATION OF ATMOSPHERIC COMPOSITION BY SOLAR ABSORPTION PHOTOMETRY
Bryan Rofe (Weapons Res. Estab.), J. H. Carver, P. J. Edwards, P. L. Gough, and A. G. Gregory [1967] 15 p refs
CFSTI: HC $3.00/MF $0.65

Molecular oxygen and total number densities in the altitude range 70 to 120 km have been determined at Woomera by rocket measurements of the atmospheric absorption of solar ultra-violet and X-radiation using non-dispersive detectors carried in a Long Tom rocket. Comparison of the measured total and molecular oxygen number densities indicates a significant change in atmospheric composition above 100 km. Absolute measurements of the solar flux for several wavelength bands within the range 1050 to 1680Å have been obtained. Author

N67-35093 Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO-SOUNDING: FREIBURG, URSI-CODE 131 [IONOSPHAEREN DATEN, VERTIKAL-ECHO-LOTUNG FREIBURG, URSI-CODE 131]
Apr. 1967 44 p
(Rept.-250F)

Tables of the customary ionospheric data with punched-card codes are presented as observed during April 1967. K.W.

N67-35094 Joint Publications Research Service, Washington, D. C.
RESULTS OF MEASUREMENTS OF SOIL CONDUCTIVITY IN THE USSR
V. Kashprovskiy 11 Jul. 1967 12 p ref Transl. into ENGLISH from Radio (Moscow), no. 9, 1963 p 40–43, 45
(JPRS-41790; TT-67-32422) CFSTI: $3.00

Radio wave propagation depends to a considerable degree on the electric conductivity of the soil. However, a large number of measurements are required to obtain a conductivity map for a large territory. The results of an unusual program are described in which hundreds of amateur radio operators participated to measure the electric conductivity of soils throughout the entire territory of the Soviet Union. The results were compiled into a map which is being used to construct routes of radio wave propagation. R.N.A.

N67-35095# Danish Meteorological Inst., Charlottenlund.
RUDE SKOV GEOPHYSICAL OBSERVATORY, MAGNETIC RESULTS, 1965
1967 39 p

Results of standard observations made during 1965 at the Rude Skov magnetic observatory in Denmark are discussed and tabulated. Equipment used, scale value determinations, absolute measurements, adopted base values, monthly mean values, and measurements on secular stations are given. The lunar-daily variation of the declination between 1952 and 1962, and diurnal variation data for each of the years is included. Four tables are included for each month: (1) hourly means of horizontal component of magnetic intensity; (2) hourly means of vertical component of magnetic intensity; (3) hourly means of magnetic declination; and (4) extreme values of magnetic elements and ranges of H, D, Z, K and C indexes. M.W.R.

N67-35121 Defence Research Board, Ottawa (Ontario).
THEORETICAL CURVES FOR THE INDUCED POLARIZATION METHOD
L. L. Van'yan, G. M. Morozova, and L. V. Lozhenicyna Jul. 1967 9 p Transl. into ENGLISH from Geol. i Geofiz., Acad. Nauk SSSR, Sibirsk. Otd. (Novosibirsk), v. 10, 1961 p 118–123
(T-476-R)

The admissibility of investigating a nonstationary process, the induced polarity effect used in mineral prospecting, in terms of the Laplace equation is discussed. One modification of the induced polarization method is the method of vertical electric soundings. The soundings are used in cases where mineral strata have horizontal dimensions considerably exceeding their thickness, and a small angle of slope. The principal quantity in vertical electric sounding is the apparent polarizability, which is defined as the polarizability of a uniform half-space such that at its surface the induced polarization effects coincide with the observed effects over a given span of surface length. A new method of calculating this apparent polarizability is shown. R.N.A.

N67-35139# Royal Aircraft Establishment, Farnborough (England).
PROJECT TOPCAT: POWER SPECTRAL MEASUREMENTS OF CLEAR AIR TURBULENCE ASSOCIATED WITH JET STREAMS
C. K. Rider (Aeron. Res. Labs.) and Anne Burns Sep. 1965 39 p refs
(RAE-TR-65210) CFSTI: HC $3.00/MF $0.65

The note presents preliminary information on the power spectral data obtained during Project TOPCAT in Australia. Measurements of moderately severe clear air turbulence were obtained from a Canberra aircraft flying at altitudes of 26,000 to 33,000 ft in the vicinity of the sub-tropical jet stream. In some respects, particularly at long wavelengths, the spectra are dissimilar to those found for low level turbulence and there are indications that the turbulence is anisotropic. At short wavelengths the power spectra agree well with a $-5/3$rd power law, and the energy densities of the three components (u_g, v_g, w_g) are similar. Author

N67-35235 Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO-SOUNDING: DAPANGO (TOGO) [IONOSPAEREN DATEN, VERTIKAL-ECHO-LOTUNG: DAPANGO (TOGO)]
Jan. 1966 39 p In GERMAN and ENGLISH

Vertical echo ionospheric sounding data recorded at Danango, Togo, are tabulated for January 1966. Data on both the E layer and the F layer are given for each hour of each day. Time is UT (Universal Time), and frequency range of the ionosonde is 1.00 to 20.00 MHz. M.W.R.

N67-35236 Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO SOUNDING: DAPANGO (TOGO) [IONOSPHAEREN DATEN, VERTIKAL-ECHO-LOTUNG: DAPANOO (TOGO)]
Feb. 1966 39 p In GERMAN and ENGLISH (For abstract see N67-35235 20-13)

N67-35237 Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO-SOUNDING: DAPANGO (TOGO) [IONOSPHAEREN-DATEN, VERTIKAL-ECHO-LOTUNG: DAPANGO (TOGO)]
Mar. 1966 39 p In GERMAN and ENGLISH (For abstract see N67-35235 20-13)

N67-35240# Defence Research Board, Ottawa (Ontario).
INTENSITY MEASUREMENTS OF RADIO EMISSION ON FREQUENCIES 725 AND 1525 KC OBTAINED BY APPARATUS ON THE ELEKTRON-2 SATELLITE
Ye. A. Benediktov, G. G. Getmancev, N. A. Mitiakov, V. O. Rapoport, Yu. A. Sazonov et al Jun. 1967 29 p refs Transl. into ENGLISH from Issled. Kosmich. Prostranstva, Tr. All-Union Conf. on Space Phys. (Moscow), 1965 p 581–606
(T-484-R)

Broadening the band of radio-astronomic measurements toward the medium and long waves requires such measurements from a satellite with a relatively high apogee so that the ionospheric effects on the results may be minimized. In this sense, the conditions of the Elektron-2 satellite were quite favorable. As it approached its perigee, Elektron-2 dipped into the ionosphere. From the change in level of the radio emission at the output of the receiving apparatus, measurements were made of the electron concentration profiles in the ionosphere over a broad range of heights. Because of the satellite's long life, the measurements were conducted over a long period of time which made it possible to detect a sporadic radio emission on the two frequencies 725 and 1525 kc. The radio receiver apparatus and measurement procedure, preliminary measurement results, and the frequency spectrum of the cosmic radio emission intensity are described. Details on the determination of the electron concentration profile and the sporadic radio emission are given. R.N.A.

N67-35280 Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, ABSORPTIONS-MEASUREMENT: FREIBURG, URSI-CODE 131 [IONOSPHAEREN-DATEN, ABSORPTIONS-MESSUNGEN: FREIBURG, URSI-CODE 131]
Feb. 1967 14 p In GERMAN

Tabulated daily absorption loss values based on mean echo amplitudes are presented for January through June 1967. K.W.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N67-34082# Utah State Univ., Logan. Electro-Dynamics Labs.
AIRBORNE ELECTRONIC ULTRA-FAST SCANNING SPECTROMETER
Doran J. Baker and Alan J. Steed 1 Mar. 1967 29 p refs
(Contract AF 19(628)-4994)
(SR-1; ARCRL-67-0220; AD-653997) CFSTI: HC $3.00/MF $0.65

An all-electronic scanning spectrometer is described which is capable of scanning the 0.6 to 1 micron spectral region at scan rates of up to 10,200 scans/second at a resolution of better than 15 A. An image dissector photoelectron multiplier tube is used as the detection device. The minimum detectable signal of the system is less than 0.000001/sq cm/A at 0.8 microns. The instrument occupies a volume of less than half a cubic foot and is designed for operation in a KC-135 aircraft. Video magnetic tape recording is used, and a digital read-out method has been developed so that the data can be programmed into a computer. Author (TAB)

N67-34090# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
DESIGN OF A PORTABLE INSTRUMENT FOR MEASURING THE RADIOACTIVE CONTAMINATION OF FOODSTUFFS [ETUDE D'UN INSTRUMENT PORTATIF POUR LA MESURE DE LA CONTAMINATION RADIO-ACTIVE DES ALIMENTS]
R. Boulenger Brussels, EURATOM, Jun. 1967 77 p refs
(Contract EURATOM-020-65-d6 PSTB)
(EUR-3265.f) CFSTI: HC $3.00/MF $0.65

This report describes the characteristics of a prototype of an apparatus for detecting radioactive contamination in foodstuffs after a nuclear accident, the contamination being assumed to be fairly extensive. The authors first conducted a critical analysis of different types of possible accidents and the isotopic composition of the mixtures of radionuclides likely to affect foodstuffs. They then drew up guide levels for the radioactive contamination of foodstuffs. The apparatus consists of a semi-portable transistorized measuring unit and a scintillation probe. The probe is enclosed in a stainless steel leaktight tube, thus facilitating cleaning and decontamination, if necessary. The detector is of high sensitivity, and the measurements are simplified by means of a single-channel system. The experiments carried out have proved the practical utility and efficiency of this instrument. Author

N67-34096# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.
FIBERCELL OVERHEAT HAZARD DETECTION SYSTEM Technical Report, Jan. 1966–Jan. 1967
Stanley Yalof Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Feb. 1967 46 p refs
(Contract AF 33(615)-3530)
(AFAPL-TR-67-62; AD-653996) CFSTI: HC $3.00/MF $0.65

The purpose of the program was the development of an airborne overheat hazard detection system, utilizing the proprietary power-generating Fibercell concept as the sensor. Such a sensor was required to have a detection capability in the primary temperature range from 300F to 1000F, plus the capacity to withstand transient temperatures in excess of these limits. In general, Fibercell consists of a ceramic electrolyte electrochemical cell in the shape of a fiber, which is dependent on its temperature for electrical power output. Since the electrolyte resistivity is logarithmically related to temperature, the cell power output lessens rapidly with decreasing temperature. Below a particular temperature (determined by ceramic electrolyte composition) the cell is effectively disconnected from the alarm system -- a behavior that lends itself to long service life of the cell. To improve power output, reliability, and response time, various combinations of materials and construction methods were employed with resulting improvement in performance. With utilization of more energetic electrodes, and other means discussed in the report, potentially greater efficiency can be achieved. Author (TAB)

N67-34139# Danish Defence Research Board, Copenhagen. Radiophysics Section.
TRANSISTORIZED DOSIMETER READER: TEST MODEL [TRANSISTORISERET DOSIMETERAFLAESER. EN FORSO-EGSMODEL]
Preben Buchhave 16 May 1966 29 p refs In DANISH; ENGLISH summary
(NP-16705)

A fully transistorized reading instrument for ionization-chamber personnel dosimeters was designed. It has a rugged moving-coil instrument for dose reading; it is portable and easy to operate. A field-effect transistor (FET) is the active element of the electrometer input. As the main purpose was to propose applicable circuits for a field instrument, only temperature tests were performed, and no attempt was made to find final solutions to such problems as dust, moisture and shock proofing, or automation and data handling. The reader design was an integrating part of a development project concerning low-cost dosimeters with time constants of more than 100 years. Author (NSA)

N67-34178# Atomic Weapons Research Establishment, Aldermaston (England).
A 12 CHANNEL, DOPPLER PROFILE SPECTROPHOTOMETER FOR PLASMA SCATTERED LASER LIGHT
A. D. Beach Apr. 1967 37 p ref
(AWRE-O-42/67) HMSO: 9s

A laser/spectrometer combination was developed for the determination of spatially and temporally resolved plasma electron temperatures in the range 200 eV to 4 keV (2 to 40×10^{6} K). The spectrophotometer described here is an f/2, diffraction grating instrument with a 12 channel, sequenced pulse output, suited for use as a laboratory tool, and compatible with the space requirements of parallel instrumentation observing the same plasma. Author (NSA)

N67-34182# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
DESIGN OF A SIMPLE HEAT FLUX METER
J. A. Businger *In its* Convective Elem. Apr. 1967 p 2–5 refs
(See N67-34181 20-13)

In an effort to obtain design data for an integrating heat flux meter, the behavior of a cylindrical rod suspended vertically in the wind is analyzed. Equations are derived to determine the similarity between drag and heat transfer in a solid aluminum rod. With a simple heat flux meter mounted at the center, the upper half of the rod was exposed to different average temperatures and wind than the lower half. It is shown that the heat flux meter requires very high conductivity and good sensitivity for very small temperature differences between the upper and lower halves of the rod. An alternate heat flux expression, with heat flux meter omitted and one solid rod with maximum conductivity used, is formulated for direct temperature difference measurements. Preliminary experiments show the need for shielding and uniformly polishing the rods to reduce errors caused by radiation. E.C.

N67-34204* Perkin-Elmer Corp., Norwalk, Conn. Electro-Optical Div.
X-RAY TELESCOPE Final Report
27 Jun. 1966 39 p refs
(Contract NAS5-9215)
(NASA-CR-87440; ER-8444) CSCL 17H

The design, development, and fabrication of two grazing incidence X-ray telescopes to operate in the 10 Å region are described. A major portion of the effort on the program was devoted to ascertaining the techniques and processes to be applied for fabrication and testing. Author

N67-34227 Joint Publications Research Service, Washington, D. C.
DESCRIPTION OF SOVIET ENGINEERING PATENTS
3 May 1967 16 p refs Transl. into ENGLISH from Komitet no Delam Izobreteniy i Otkrytiy Pri Sovete Ministrov SSSR, nos. 2, 4, 18, 24
(JPRS-40884; TT-67-31526) CFSTI: $3.00

CONTENTS:

1. DEVICE FOR COMPUTING CORRELATION FUNCTIONS V. P. Zelenen'kiy p 1–2 (See N67-34228 20-08)
2. SONIC FIELD ANALYZER L. B. Preyzer and A. A. Lazarenko p 3–4 (See X67-34229 20-14)

3. METHOD OF FINDING THE ENVELOPES OF CORRELATION FUNCTIONS S. I. Davydov and V. A. Vyatkin p 5–6 (See N67-34230 20-14)

4. INSTRUMENT FOR DETERMINING THE SLOPE OF UNDERWATER SURFACES OF HYDRAULIC ENGINEERING STRUCTURES G. A. Arst, V. F. Kovalenko, and V. Z. Kheyfits p 7–9 (See N67-34231 20-14)

N67-34229 Joint Publications Research Service, Washington, D. C.

SONIC FIELD ANALYZER

L. B. Preyzer and A. A. Lazarenko *In its* Description of Soviet Eng. Pat. 3 May 1967 p 3–4 (See N67-34227 20-14)

Sonic field analyzers are known which contain a clipper-limiter circuit of impulses, time selector, translator device, and an indicator. In the suggested analyzer, the memory unit and the electronic key are connected in parallel to the clipper-limiter circuit, the electronic computer bar, and one of the legs of the trigger, and turn on the generator of the time selector. The other leg of the trigger is connected to the electronic computer bar. Such an arrangement of the analyzer makes it possible to receive information on the distribution of reflections by levels or degrees, delay time, and number of reflections which fall upon the investigated point of the sonic field with a level exceeding a certain given level. Author

N67-34230 Joint Publications Research Service, Washington, D. C.

METHOD OF FINDING THE ENVELOPES OF CORRELATION FUNCTIONS

S. I. Davydov and V. A. Vyatkin *In its* Description of Soviet Eng. Pat. 3 May 1967 p 5–6 (See N67-34227 20-14)

The usual method of finding the envelopes of a correlation function is by means of the preliminary detection of the delayed and direct signals with subsequent enlargement and averaging. In order to eliminate a high frequency component correlation in the Paige correlator it is suggested that a delay of the heterodyne voltage (before formation of the network of heterodyne voltage) be introduced in a magnitude equalling the delay of the signal in the displacement channel of the spectrum of the delayed signal in the field of the video frequency. The magnitude of the delay is selected as equal to the delay of the investigated signal by which from the phase of each spectral component of the delayed signal is subtracted the phase of the component at the average frequency of the spectrum. A result of the envelopes of the correlation function of the input signal is received during enlargement of the voltages at the outputs of the channel narrow band video amplifiers. Author

N67-34231 Joint Publications Research Service, Washington, D. C.

INSTRUMENT FOR DETERMINING THE SLOPE OF UNDERWATER SURFACES OF HYDRAULIC ENGINEERING STRUCTURES

G. A. Arst, V. F. Kovalenko, and V. Z. Kheyfits *In its* Description of Soviet Eng. Pat. 3 May 1967 p 7–9 (See N67-34227 20-14)

During the construction and exploitation of hydraulic structures it is necessary to determine the slope of their underwater surfaces. There are instruments for this purpose which include installed gravitational pendulums in a hermetic enclosure attached at the axles of the rotors of the pickups of revolution angles. However, these instruments do not guarantee sufficient measurement accuracy. In order to increase the accuracy of measurements the gravitational pendulums in the suggested instrument are located at angles of 90 degrees to each other on the supporting area, perpendicular to the planes of their roll. The interior band of the hermetic enclosure is filled with a damping or shock-proof fluid. A design sketch of the suggested instrument and its electric circuit is presented. Author

N67-34260# Stanford Research Inst., Menlo Park, Calif.

MANUAL FOR ARN-3 TYPE ATMOSPHERIC NOISE MEASURING EQUIPMENT Special Technical Report No. 27

Ralph L. Brown Nov. 1966 153 p refs

(Contract DA-36-039-AMC-00040(E); ARPA Order 371)

(AD-653780) CFSTI: HC $3.00/MF $0.65

Equipment has been developed and constructed for use in studies of atmospheric noise in Thailand. Average noise power and the mean envelope voltage can be measured at eight frequencies in the VLF, LF, MF, and HF bands. The design of this equipment is derived from the National Bureau of Standards (now ESSA) ARN-2 noise-measuring equipment. The equipment is operated in conjunction with the standard ARN monopole and ground plane and so the data obtained are compatible with data from the existing worldwide network of noise stations coordinated by ESSA, Boulder, Colorado. Impulsive voltages induced in the standard antenna by local thunderstorms are recorded at several threshold levels by lightning-flash analyzer equipment to supplement the ARN type data. This report is intended as an operation and maintenance manual. It explains the principles of operation and includes schematic diagrams and sample records as well as a description of calibration and data-reduction procedures. Author (TAB)

N67-34298# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

FULL-ENERGY-PEAK EFFICIENCIES OF THREE GAMMA-RAY DETECTORS

G. L. Hanna, D. G. Walker, and P. M. Beach Apr. 1967 19 p refs

(AAEC/TM384) CFSTI: HC $3.00/MF $0.65

Two sodium iodide scintillators and a lithium-drifted germanium detector are used in the analysis by gamma-ray spectrometry of gaseous fission products obtained in sweep-capsule fission product release experiments. A description is given of the full-energy-peak efficiencies of the three detectors for the source geometries used in counting the fission product samples. Experimental efficiencies are compared with calculated efficiencies for one of the sodium iodide detectors. Measurements made of the resolutions obtained with each detector are also noted. Author

N67-34322 Joint Publications Research Service, Washington, D. C.

LARGEST CORONOGRAPH INSTALLED AT KISLOVODSK MAIN ASTRONOMICAL OBSERVATORY

M. N. Gnevyshev, G. M. Nikol'skiy, and A. A. Sazonov 2 Aug. 1967 7 p ref Transl. into ENGLISH from Priroda (Moscow), no. 6, 1967 p 71–73

(JPRS-42059; TT-67-32689) CFSTI: $3.00

Design and installation data for a large Lyot coronagraph with a stationary, high dispersion spectrograph are presented. The coronagraph is mounted in a forked equatorial mounting with an electrical clock mechanism consisting of a quartz generator with a fixed stable frequency. A special device allows approximate and fine correction motions in both coordinates. The diameter of the main objective is 535 mm, focal length is 8000 mm, and resolution is 0".4. The diameter of the solar image on the artificial moon is 75 mm and on the spectrograph slit is 125 mm. Preliminary tests show that the amount of scattered light in the coronagraph is less than or equal to 11^{-5}. The spectrograph diffraction grating has 600 rulings/mm on a lined surface measuring 250×230 mm with second order light concentration. A diagram of the coronagraph along with specific operating characteristics is given. E.C.

N67-34379 Flying Personnel Research Committee, London (England).
A RAPID RESPONSE FLAME DETECTION SYSTEM
A. B. Pignatelli (Royal Air Force, Farnborough (England)) Jan. 1966 12 p ref
(FPRC/Memo-228)

Fires in oxygen rich environments are of a fundamentally different character to those in air and they can cause fatal damage to man within a few seconds. This report describes a rapid response flame detection system specifically developed to combat the consequences of such fires. Author

N67-34423# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
AN AUTOMATIC LINEAR VARIABLE DIFFERENTIAL TRANSFORMER (LVDT) CALIBRATOR
H. H. Cromwell and W. W. Lee 26 Apr. 1967 82 p refs
(Contract W-7405-ENG-26)
(Y-1567) CFSTI: HC $3.00/MF $0.65

A system for automatically calibrating a linear variable differential transformer (LVDT) employs a small digital computer and an optical interferometer. The interferometer is used to measure displacements. Interfacing circuits enable the computer to control external equipment and track armature displacement. The computer contains an analog-to-digital converter which reads the LVDT output voltage while the armature is moving. Appropriate software performs mathematical operations on the data and types the results on a teletype. Calibration time is reduced from approximately two hours to approximately two minutes. Tests indicate that total uncertainty in the output is ±0.08 percent at the 95 percent confidence level. Author (NSA)

N67-34430 Flying Personnel Research Committee, London (England).
A SENSITIVE RECORDING BALANCE FOR WEIGHING HUMAN SUBJECTS
D. McK. Kerslake (Royal Air Force, Farnborough England). Jul. 1966 21 p
(FPRC/Memo-232) .

The weight of the subject and his support is counterbalanced by the buoyancy of floats immersed in oil. Changes in weight cause changes in the level at which the system floats. Errors due to changes in temperature of the oil are avoided by appropriate design of float system and the tank which contains it. Slow changes of an inert weight of 100 Kg can be measured with an accuracy of about ±50 mgm, but in the case of a living subject the useful sensitivity is of the order of ±0.1 gm. Author

N67-34444# California Univ., Livermore. Lawrence Radiation Lab.
CONSTRUCTION AND OPERATION OF A FAST ION GAUGE IN THE 2X MACHINE
Robert E. Ellis 5 Mar. 1967 15 p refs
(Contract W-7405-ENG-48)
(UCID-15105) CFSTI: HC $3.00/MF $0.65

A fast ion gauge has been constructed and used to determine the neutral pressure during the formation and decay of a plasma in the 2X machine. The gauge has been operated in a magnetic field of 2000 gauss and appears to be quite rugged and reliable. Some preliminary results of measurements in the gettered (with titanium vapor) and ungettered 2X system are given. Author (NSA)

N67-34475# Army Materials Research Agency, Watertown, Mass.
PAPER 3-INFRARED MULTIPLE-SCAN BOND INSPECTION SYSTEM
Paul E. J. Vogel *In its* Defense Conf. on Nondestructive Testing 1966 p 69-75 ref (See N67-34467 20-15)

To inspect bond integrity or other material characteristics that influence infrared radiation, an infrared multiple-scan system was developed. A description of the detector head, chopper, amplifier, signal switcher, and related instrumentation is provided. Experimental results indicate that the multiple scan inspection system, in a more refined package, would offer a simple, inexpensive, and effective nondestructive testing tool able to furnish a meaningful display to a semi-skilled user. R.U.

N67-34524# Itek Corp., Lexington, Mass.
DEVELOPMENT OF AN EXPLORATORY DEVELOPMENTAL PHOTOGRAPHIC CONTACT AND PROJECTION PRINTER Final Report, 22 Jun. 1965-29 Oct. 1965, 19 Jun. 1966-30 Dec. 1966
J. L. Breitbord and R. E. Morris Jun. 1967 58 p refs
(Contract DA-28-043-AMC-00177(E))
(ECOM-00177-F; AD-653625) CFSTI: HC $3.00/MF $0.65

Under contract DA 28-043 AMC-00177 (E), Itek has designed and fabricated a multifunction contact and projection printer capable of making 2x and 4x enlargements and of performing contact printing in a step and repeat mode. In addition, the printer provides automatic dodging, automatic exposure control, contrast control, automatic registration of the negative, and multiple copies of any single negative. The printer can handle 500-foot rolls of 70-millimeter, 5-inch, and 9 1/2-inch duplicating film, as well as 9 3/8-inch variable contrast paper. With the exception of the print cycle (design goal was 3 seconds, excluding the exposure duration of 4 seconds), the numerous and difficult specifications in the SCL-4611 technical requirements have been met. With a 4-second exposure, relatively good exposures can be obtained in the 4x enlargement modes. The dodging in this mode was 20 percent. Resolutions on the order of 100 lines per millimeter AWAR have been obtained in the 2x and 4x enlargement modes. In the contact mode, the resolution is approximately 50 lines per millimeter. Dodging on the order of 60 to 70 percent can be obtained in the 2x and contact modes. The registration function operates reliably. The automatic exposure control is very sensitive; it operates well in the 2x and 4x enlargement modes. The unit tracks all the duplicating film formats as well as the variable contrast paper. Because of its operational simplicity, the phosphor quench dodging technique is distinctly superior to other methods of dodging; however, the numerous other functions required by this printer make it a highly complex unit. Author (TAB)

N67-34529# Thornthwaite (C. H.) Associates, Centerton, N. J. Climatology Lab.
DEVELOPMENTS IN METEOROLOGICAL SENSORS AND MEASURING TECHNIQUES TO 150,000 FEET, 1966 Final Report, Mar. 1, 1966-Feb. 28, 1967
John R. Mather Jun. 1967 183 p refs
(Contract DA-28-043-AMC-01919(E))
(ECOM-01919-F; AD-653622) CFSTI: HC $3.00/MF $0.65

Results of a continuing survey of recent developments in meteorological sensors and techniques for measuring temperature, wind, humidity, ozone, pressure, density and radiation (solar and terrestrial) by balloons and rockets up to about 150,000 feet are presented as an annotated bibliography of 277 items as well as more detailed analyses of the current state-or-the-art and promising developments in each of the seven sensor fields. The report also includes an introduction describing the general meteorological characteristics and thus the instrumental needs in the stratosphere. The text includes 123 references. Author (TAB)

N67-34549# National Bureau of Standards, Boulder, Colo. Radio Standards Lab.
THE DESIGN AND OPERATION OF A HIGH VOLTAGE CALIBRATION FACILITY
Winston W. Scott, Jr. 10 Nov. 1966 32 p refs
(NBS-TN-349) GPO: $0.25

The high-voltage calibration facility, at NBS Washington, is described with emphasis on several novel construction features and calibration techniques. The more usual calibration techniques are also outlined for the assistance of those personnel in standards laboratories assigned the task of calibrating with high accuracy, electrostatic voltmeters, resistive dividers, and potential transformers at high voltage. Precautions, based on experience in the calibration and use of high voltage standards, are given so that certain errors may be avoided by the users. Author

N67-34578# Bureau of Mines, Denver, Colo.
THREE-COMPONENT BOREHOLE DEFORMATION GAGE FOR DETERMINING THE STRESS IN ROCK
Robert H. Merrill Aug. 1967 44 p refs
(BM-RI-7015)

This Bureau of Mines report summarizes the design and tests of a gage that will simultaneously measure the deformation of a borehole along three diameters 60 degrees apart; the measurements are in a single plane normal to the axis of the borehole. The inherent errors in measurement are considered together with the problems associated with the use of the gage in the relatively severe environments in and around mine openings. These problems were treated in the design and tests of the gage and the results establish that the gage can be used to satisfactorily determine estimates of the stresses in rock. Author

N67-34606*# Trans-Sonics, Inc., Burlington, Mass.
CAPACITANCE PROPELLANT GAGING STUDY FOR ORBITING SPACECRAFT Final Development Report
Jun. 1967 98 p
(Contract NAS8-18059)
(NASA-CR-87496) CFSTI: HC$3.00/MF$0.65 CSCL 14B

A unique approach to the problem of gaging propellant tanks in a zero gravity environment uses a capacitance technique in which surface electrodes are attached to the inside tank wall so that the whole tank becomes the inside of a capacitor. The shapes and potentials of the electrodes are adjusted so that the interior electric field is approximately uniform throughout the tank, insuring equal weighting to all regions, regardless of how the liquid is distributed. A theoretical analysis of the field distribution in a cylindrical tank showed that satisfactory uniformity can be obtained with a reasonable number of electrodes, and that the errors caused by the surface charges on the liquid interfaces are not significant in the cases of liquid hydrogen and liquid oxygen, particularly if the readings are averaged over two orthogonal directions of the field. The method for eliminating the leakage capacitance to the tank wall was found to be inadequate and new methods for overcoming this problem were evolved. Author

N67-34636# United Kingdom Atomic Energy Authority, Dounreay (Scotland). Experimental Reactor Establishment
X-RAY DIFFRACTOMETRY TECHNIQUES FOR CERAMIC FUELS
W. B. Bremner and D. B. White [1967] 10 p refs
(TPG-1309(D)) HMSO: 3s

The design of suitable diffractometer-sample containment involving a nitrogen/argon two-gas system is described. Various mounting techniques are discussed and their relative merits are outlined. It was found that a resin mounting technique was most suitable for diffraction line profile measurements when (U Pu)O_2 was being examined. Analysis of small amounts of sesquicarbide and oxide phases in (U Pu)C was carried out using a paraffin wax binder followed by low-pressure pelleting. Examples of the application of these and other diffractometry techniques are given. Author

N67-34671*# ITT Industrial Labs., Fort Wayne, Ind.
A DAY–NIGHT HIGH RESOLUTION INFRARED RADIOMETER EMPLOYING TWO-STAGE RADIANT COOLING Quarterly Report, 1 Jan.–1 Apr. 1967
15 Apr. 1967 85 p refs
(Contract NAS5-10113)
(NASA-CR-87807; ITTIL-67-1015; QR-4) CSCL 20F

This report describes technical progress in the development of a two-stage radiant cooler to be used in a 10.5 to 12.5 micron day–night high resolution infrared radiometer. It outlines mechanical construction and improvements in mechanical design and assembly. Photographs of the thermal-vacuum test facility are included. A single-ended two-stage radiant cooler of simplified design is described and analyzed. Previous calculations of effective patch-to-cone emissivity are shown to be accurate. Joule heating of the detector at optimum bias is shown to be compatible with the second stage of radiant cooling. Finally, optical design and measurements are covered. Author

N67-34687 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
ON THE PREPARATION OF LITHIUM-DRIFTED SILICON DETECTORS [OTRZYMYWANIE KRZEMOWYCH DETEKTOROW DRYFOWYCH]
Wincenty Przyborski, Janina Chwaszczewska, and Wieslaw Czarnacki 1967 25 p refs
(INR-800/II/PS)

The results of a study of lithium mobility in boron and gallium doped silicon single crystals grown either by zone floating or Czochralski's methods are given. The influence of dislocations on the drift process, compensation quality and reverse current of Li-drifted diodes is outlined. A description of Li-drifted detector preparation technique, involving some advances, is presented. Author

N67-34733 Royal Aircraft Establishment, Farnborough (England).
ON THE THEORY OF OSCILLATING-VANE VACUUM GAUGES
W. N. Mair Jan. 1967 19 p refs
(RAE-TR-67024)

Previous theories of the damping force, exerted by the gas on the vane of an oscillating-vane vacuum gauge, have assumed elastic collisions for the non-equilibrium situation of the moving surface; this is equivalent to assuming that the collision mechanism is one of specular reflection with an accommodation coefficient of zero. A main aim of the present paper is to point out that the assumptions of specular reflection and zero accommodation are unrealistic, and to present a theory which avoids these limitations by considering the effects of cosine-law scattering and non-zero accommodation coefficients. Exact expressions are derived for the rate of molecular impacts and for the fluxes of gas kinetic energy and normal momentum seen by an observer on the moving vane. These are also expressed in series-expansions for the case of a vacuum gauge, for which the speed of the vane V is much less than the mean velocity $\bar{c}$ of the gas, and (in an Appendix) for the case of a satellite in the earth's upper atmosphere, for which V > $\bar{c}$. Author

N67-34759*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ELECTRONICS FOR A MARTIAN WATER VAPOR DETECTION SYSTEM
John R. Locke 15 Aug. 1967 19 p refs
(Contract NAS7-100))
(NASA-CR-86771; JPL-TR-32-1114) CFSTI: HC $3.00/MF $0.65 CSCL 09C

An electronic circuitry was developed to complement an aluminum oxide detector of high sensitivity which has been proposed for investigating the water content of the Martian atmosphere and /or surface. The detector and electronics constitute an instrument that has many advantages, some of which are small size (less than 36 $in.^3$), light weight (approximately 0.8 lb), low power requirements (less than 0.4 W), and digital data output without the need of an analog-to-digital converter. The theory of operation is described qualitatively, and a quantitative relationship is developed between water vapor concentration and the output signal of the instrument. The effects of temperature are treated and a brief analysis of the system power supply is discussed. Author

N67-34772*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR AND PLANETARY INSTRUMENTS
In its Space Programs Sum. No. 37-45, Vol. IV 30 Jun. 1967 p 197-202 (See N67-34761 20-30)

Control circuitry designs are examined in relation to their use in wet chemistry experiments in earth orbit or on a planetary surface. The many processes and setup steps needed to obtain specific chemical reactions are identified as pump cycling, valve positioning, filling or emptying a test cell of fluid, proportioning fluids, mixing fluids, and extracting a representative test sample from a larger volume of fluid. Specifications for the circuitry are cited as integrated circuits to perform the logic functions, discrete components to buffer the integrated circuits and to act as drivers or current amplifiers for the prime movers, level change rather than pulse operation, and minimum use of monostable and bistable multivibrators due to their sensitivity to false triggering. Schematics and a brief description are presented on the waste pump cycle control, valve position control, test cell plunger control, revolution counting for metering of fluids, and fluid sample control. M.G.J.

N67-34773*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE INSTRUMENTS
In its Space Programs Sum. No. 37-45, Vol. IV 30 Jun. 1967 p 203-221 refs (See N67-34761 20-30)

A small, fast, fixed-grating, multidetector spectrometer, specifically designed to measure the low spectral steradiancies expected for the Martian atmosphere, is discussed in relation to the most suitable location for such detectors. The factors affecting the minimum temperatures that can be accurately measured with the instrument are assessed. The requirements for determining the absolute temperature of the Martian surface by measuring its emitted thermal radiation are defined as (1) knowing the relation between the spectral steradiancy of the surface and its temperature, and the response of the measuring instrument to the incoming radiation; and (2) correcting for additional radiation entering the instrument, and for absorption occurring between the surface and the instrument. Each of these requirements is considered in detail. It is concluded that Martian surface temperatures above 180°K can be determined to 5°K. A statistical analysis was performed to assess the applicability of stereophotogrammetry to extraterrestrial mapping problems. Preliminary results indicate that, although the technique offers promise, it is somewhat limited under existing conditions. M.G.J.

N67-34796 European Organization for Nuclear Research, Geneva (Switzerland). Nuclear Physics Apparatus Div.
UZU—A PROGRAM WHICH SIMULATES BUBBLE CHAMBER TRACKS
H. Yoshiki 13 Apr. 1967 95 p refs
(CERN-67-10)

The program UZU monitors the geometrical reconstruction programs in the bubble chamber analysis by producing simulated tracks with given initial parameters. It can be applied to any bubble chamber equipped with a homogeneous magnetic field, a parallel plate window, and three cameras whose optical axes are perpendicular to it. By means of control cards, it can simulate the tracks of pure helix, with measurement errors, with single or multiple scattering, with ionization loss, with bremsstrahlung, or any other combinations of these. It can test the reconstruction programs in various ways, such as mathematical correctness of the program, the mean value by the reconstruction program, their variances, the adequateness of various criteria (for the scanning or the measurement) and of corrections. Author

N67-34839# Aircraft Research Association, Ltd., Bedford (England).
A STATIC TEST RIG FOR THE MEASUREMENT OF THRUST EFFICIENCY AND DISCHARGE COEFFICIENT OF PROPELLING NOZZLE SYSTEMS
L. W. Akers Apr. 1967 26 p refs
(ARA-WTN-62) CFSTI: HC $3.00/MF $0.65

The construction and development of a static thrust rig for the measurement of efficiency and discharge coefficients of propelling nozzles is described. Included are results of a series of tests on calibration and various shrouded nozzles which demonstrate the accuracy and repeatability of the rig. The two calibration nozzle results are compared with those obtained in other studies. Author

N67-34892 Central Lab. for Radiological Protection, Warsaw (Poland).
A SIMPLE FAST CHARGE-TO-PULSE CONVERTER FOR THERMOLUMINESCENCE READ-OUT DEVICE [PROSTY UKLAD SYYBKIEGO KONR ERTERA LADUNKU ELEKTRY CZNEG DO THERMOLUMINESCENCYJNEGO URZADYENIA ODCZYTOWEGO]
St. Glowacki 1967 14 p
(CLOR-64/D)

The converter is fed by a photomultiplier viewing the light emitted by the thermoluminophor during heating. The converter's response is linear for a wide range of input currents, ranging from $5\text{-}10^{-9}$A up to 10^{-3}A. The idea of the circuit is based on charging the input capacitance of the converter by the current flowing from photomultiplier to the input of the converter, and on the subsequent fast discharging of this capacitance when the voltage across it surpasses a definite value. Depending on the loading current, the frequency of the circuit may reach 0.5 MHz for the highest current of 10^{-3}A. The pulses from a discharging generator drive a scaler, indicating the total amount of emitted light. Author

N67-34925 Lockheed Missiles and Space Co., Palo Alto, Calif.
DETERMINATION OF THE SPECTRAL DENSITY AND CORRELATION FUNCTIONS BY PROCESSING OSCILLOGRAPH EXPERIMENT RECORDS
S. I. Peshkov [1967] 5 p Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Mashinostr. (Moscow), no. 1, 1967 p 56-59

A discussion is presented on the method of determining the functions from records obtained on a tractor component longevity experiment. Expressions are developed for the mean number of excursions as well as the spectral density and correlation functions. An approximate determination of the expected endurance of the components is indicated. N.E.N.

N67-34954# Douglas United Nuclear, Inc., Richland, Wash. Instrument and Electrical Development Unit.
HIGH SPEED SCANNING SYSTEM TEMPERATURE MONITOR
R. Sherrard [1967] 20 p Presented at the Conf. of Instr. Soc. of Am., Richland, Wash., 21 Mar. 1967
(DUN-SA-32; CONF-670319-1) CFSTI: HC $3.00/MF $0.65

A scanner system for monitoring reactor temperatures is described. The system is a dual one containing both high speed and low speed scanning. The high speed portion of the system examines each of 3200 temperatures in 200 microseconds and covers the entire process in 0.744 seconds. The low speed system is used for automatic logging of temperatures in reactor format on a preprinted form at a speed of 4.5 temperatures per second and for traverse and trend recording of all temperatures. The program history major benefits from on-reactor use, physical layout of scanner system, a description of scanner system functions, and reliability performance of the scanner system are discussed. NSA

N67-34958 Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
HIGH RESOLUTION TIME MEASUREMENT WITH HIGH POWERED SCINTILLATION COUNTER [MISURE DI TEMPO AD ALTA RISOLUZIONE CON RIVELATORI A SCINTILLAZIONE DI GRANDI DIMENSIONI]
L. Paoluzi and R. Visentin 21 Apr. 1967 14 p refs In ITALIAN *Its* Nota Interna No. 362
(LNF-67/31)

The experimental technique and the measurement method for increasing the efficiency of a scintillation counter are reported. The measurement of cosmic rays at the ADONE installation in Italy contributed to confirming the feasibility of the technique. R. Ll.

N67-34970 European Organization for Nuclear Research, Geneva (Switzerland). Synchro-Cyclotron Machine Div.
AN INDUCTIVE BEAM MONITOR FOR THE EXTRACTED PROTON BEAM OF THE CERN SYNCHRO-CYCLOTRON
R. Hohbach and S. Mango 12 Apr. 1967 49 p refs
(CERN-67-9)

An inductive beam monitor, as used for the extracted proton beam of the CERN synchrocyclotron, is described. It measures the number of protons passing through its aperture in a single burst, a second, or any other time interval, without interfering with the beam. It gives analogic and numerical displays of the result, and has easy and fast calibration facilities. Author

N67-34974# European Atomic Energy Community, Ispra (Italy). Reactor Physics Dept.
THEORY OF A NEUTRON POLARIMETER
R. Misenta Apr. 1967 44 p refs
(EUR-3291.e)

An experimental arrangement is proposed for the separation of those neutrons which have been scattered from an initially polarized beam of thermal neutrons without change of their initial spin direction, from those which have reversed their spin direction. This proposed neutron polarimeter consists of a polarizing crystal and of an analysing system. The polarizing crystal monochromatizes and polarizes the incident neutron beam from the reactor. The analysing system analyses the polarization and the energy of the scattered beam. It has two different states for the polarization analysis. In the parallel state only those neutrons pass the analysing system and reach the detector which have maintained, and in the antiparallel state only those neutrons which have reversed their initial spin direction. In addition to the polarization analysis the energy of those neutrons which pass the analysing system, is measured by this system. The theory of a neutron polarimeter is developed. The influence of deviations of the polarization and analysing efficiencies from 1 on the measuring accuracy of the polarization degree of the scattered beam is discussed and correction factors are derived. Author

N67-34984# Institut Franco-Allemand de Recherches, St. Louis (France).
DETERMINATION OF THE LUMINANCE IN EACH POINT OF A RAPIDLY MOVING SYMMETRICALLY ROTATING SPRING BY PHOTOGRAPHIC IMAGE [DETERMINATION DE LA LUMINANCE EN CHAQUE POINT D'UNE SOURCE DE REVOLUTION, EN MOUVEMENT ULTRA-RAPIDE, A PARTIR D'ENREGISTREMENTS PHOTOGRAPHIQUES]
J. Vauvrecy and P. Smigielski (Inst. d'Optique Theorique et Appliquee) 22 Dec. 1966 23 p refs In FRENCH
(ISL-T-43/65) CFSTI: HC $3.00/MF $0.65

A method is propcsed for calculating the luminous intensity $L_\lambda(\rho,z)$ of a nonabsorbent rotation-symmetric source. The method is applicable to a stationary as well as to a rapidly moving source; it is based on the solution of an integral equation which links the luminous intensity with the density of a photographic emulsion. Transl. by K.W.

N67-34992# Sandia Corp., Albuquerque, N. Mex.
MICROBAROGRAPH SYSTEMS STUDY
J. G. Lareau May 1967 32 p
(Contract AT(29-1)-789)
(SC-DC-67-149) CFSTI: HC $3.00/MF $0.65

A microbarograph system was developed which is reliable and compact. An analysis of the system presently in use, the design information and equipment needed for analysis, and the proposal system are presented. NSA

N67-35084# Israel Program for Scientific Translations, Ltd., Jerusalem.
COMPARATIVE STUDY OF METHODS FOR DETERMINATION OF PARTICLE SIZE
Jaroslav Simecek *In its* Hyg. Effects and Control of Dusts, Fogs, Gases, Vapors, Radioact. Particles 1966 p 18-26 refs (See N67-35081 20-34)

The following methods for particle size determination are compared: optical microscopy, sedimentation pipette methods, simplified sedimentation pipette method, the Leitz sedimentometer, Gallenkamp and Sartorius sedimentation balances, Bahco centrifugal elutriator, and Gonell air elutriator. Two types of test dusts (quartz and fly ash) were used to investigate the accuracy of the methods, the time consumed, and the problem of the dust quantities required. The different methods were assessed with regard to their suitability for industrial and hygiene purposes. Author

N67-35087# Israel Program for Scientific Translations, Ltd., Jerusalem.
SOME REMARKS ON COMPARATIVE DUST PRECIPITATION MEASUREMENTS
Helmut Nagel *In its* Hyg. Effects and Control of Dusts, Fogs, Gases, Vapors, Radioact. Particles 1966 p 39–40 refs (See N67-35081 20-34)

Studies on the possibility of comparing the results of different dust precipitation measurements, or even converting values obtained with different instruments, are discussed. It is shown that it is an inadmissible generalization to consider conversion factors for dust measuring apparatus, obtained in a measuring field, as factors of general validity. The influence of environment on dust precipitation measurements is so important that conversion of values obtained by different measuring instruments is very doubtful. The measured values are tabulated. Author

N67-35123 National Physical Lab., Teddington (England). Aerodynamics Div.
THE ACCURACY OF PRESSURE TRANSDUCERS WHEN USED IN SHORT-DURATION WIND TUNNEL FACILITIES
L. Pennelegion, K. Wilson, and B. Redston 19 Oct. 1966 44 p refs
(NPL-AERO-1213; ARC-26577)

Calibrations have been made of some pressure transducers in the pressure ranges 0–20, 0–100, and 0–760 mm Hg. The pressure step was applied in a time of 2–3 ms. Standard deviations have been computed and are used for comparisons, and for estimation of accuracies in a shock tunnel flow. A few measurements are presented of acceleration sensitivities. Author

N67-35125# California Univ., Berkeley. Lawrence Radiation Lab.
MEASURING EQUIPMENT FOR THE EXACT POINT-BY-POINT DETERMINATION OF LARGE-SURFACE MAGNETIC FIELDS [MESSAPPARATUR ZUR GENAUEN PUNKTWEISEN BESTIMMUNG GROSSFLAECHIGER MAGNETFELDER]
G. Schadebrodt Mar. 1967 11 p Transl. into ENGLISH from IEEE Trans. on Magnetics, v. MAG-2, no. 3, 1966 p 547–549 Presented at the Intermag Conf., Stuttgart, 20–22 Apr. 1966
(UCRL-TRANS-1347; CONF-660436-2) CFSTI: HC $3.00/MF $0.65

The principle underlying the method of automatic measurement of air gap flux densities is discussed. With this, a search coil is used and the voltage by time area is converted into a sequence of pulses in a voltage frequency transformer. An after-connected counter effects indication of the voltage by time area in decimal form. The measuring program can be punched in digital form on a tape. The accuracy obtainable as well as the various sources of errors are dealt with. Author (NSA)

N67-35132 Meteorological Office (Gt. Brit.).
AN ATMOSPHERIC DIFFUSION SLIDE-RULE
C. E. Pallington London, HMSO, 1966 42 p refs *Its* Scientific Paper No. 24
(MET-O-744) HMSO: 5s 6d

A slide rule is described that can be used to calculate concentrations and dosages in clouds of aerosols being transported and diffused by atmospheric wind and turbulence. The slide rule includes scales for incorporating into the calculations several methods of assessing depths and widths of diffusing clouds, but the relative merits of the methods are not discussed in detail; the main purpose of the paper is to present the slide rule as a calculating aid. The slide rule is not intended for laymen to the subject of atmospheric diffusion; it is more for those who have at least a little understanding of the theoretical background. For such users the slide rule provides a means of predicting or assessing experimental diffusion observations; it facilitates comparison of various methods of diffusion calculations and it enables a user to compile tables or graphs suitable for use by laymen. Author

N67-35164# Institut für Plasmaphysik G.m.b.H., Garching (West Germany).
LIGHT INTENSIFICATION OF THE TUBE P 829 A (ENGLISH ELECTRIC VALVE) AND LIGHT FLUX LOSSES OF THE OBJECTIVES [LICHTVERSTAERKUNG DER ROEHRE P 829 A (ENGLISH ELECTRIC VALVE), SOWIE ABBILDUNGS- UND OEFFNUNGSVERLUSTE VON OBJEKTIVEN]
H. Baumhacker and F. V. Woyna Feb. 1966 14 p In GERMAN; ENGLISH summary
(IPP-4/48)

Light gain data were measured for an image converter with a P-829-A tube (England Electric Valve). An f/1.4 front lens from Boyer/Paris, with a focal length of 100 mm, was used. The relay camera was a Tektronix Oscilloscope camera type C 19, f/1.5, 100 mm. The intensification data were obtained separately for image tube and optics. Author

N67-35167# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
THEORETICAL AND EXPERIMENTAL STUDY OF A NUCLEAR INDUCTION GYROMETER [ETUDE THEORIQUE ET EXPERIMENTALE DU GYROMETRE A INDUCTION NUCLEAIRE]
Guy Hanuise (M.S. Thesis—Paris Univ.) 1967 55 p refs In FRENCH; ENGLISH summary
(ONERA-Publ.-118(1967)) CFSTI: HC $3.00/MF $0.65

The nuclear-induction gyrometer is a configuration of nuclear magnetic resonance characterized by a directing magnetic field of the form $(H_0+H_1\cos\omega t)$. This makes it sensitive to rotations and to continuous magnetic fields perpendicular to the directing field. The theory of this system is based on a generalization of the rotating frame to the case of a variable angular velocity. The results are related to those of the theory of multi-quantum transitions. The experimental results show the effect of the various parameters on the signals observed. Working as a gyrometer gave the measurement of the sign and of the value of the gyromagnetic ratio of the proton. The admissible characteristics of an operational gyrometer of this type are discussed. The main problem lies in the necessity of a magnetic shielding of a very large attenuation coefficient. Author (ESRO)

N67-35258 Kleinwachter Entwicklungs- und Forschungslabor, Baden (West Germany).
HIGH FREQUENCY FLYING ATTITUDE GAUGE AND FORWARD COUNTING AND BACKWARD COUNTING RADIO INTERFEROMETER [HOCHFREQUENZ-FLUGLAGEMESSER UND VOR- UND RUECKWAERTSZAEHLENDES RADIOINTERFEROMETER]
H. Kleinwaecher Oct. 1966 12 p refs In GERMAN Presented at DGRR and WGLR Ann. Conf., Bad Godesberg, West Germany, 4–8 Oct. 1966 *Its* Paper No. 66-102
(Rept.-3)

Described is a high frequency attitude meter that utilizes plane polarization of linearly polarized electromagnetic waves to transmit position information between the aircraft and the ground antenna. Three dipole emitters, fastened to the aircraft in a triangle arrangement, send the linearly polarized waves to a ground antenna that uses a low frequency dipole to measure the angle of the orthogonal projection in order to obtain the geometric position of the aircraft. Also discussed is a radio interferometer that uses two phase shifting high frequency signals to obtain the phase angle by differential counting for subsequent telemetry onto a ground based oscillograph. Transl. by G.G.

N67-35268# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
DESIGN OF A SELECTIVE MODULATION SPECTROMETER [ETUDE D'UN SPECTROMETRE A MODULATION SELECTIVE]
Andre Girard (M.S. Thesis—Paris Univ., Orsay, France) 1967 63 p refs In FRENCH; ENGLISH summary
(ONERA-Publ.-117(1967)) CFSTI: HC $3.00/MF $0.65

A general survey of a spectral analysis method using a grill spectrometer is presented. Principles of this selective modulation spectrometer are detailed, along with some practical problems in its use. General conditions for using grills are discussed, as are the elimination of spectra of weak resolution and the various frequency zones. Principles of a method for analyzing an image by a Fourier transform are included. Transl. by M.W.R.

N67-35275 European Organization for Nuclear Research, Geneva (Switzerland).
VISCOMETRIC DOSIMETER OPERATING IN THE RANGE 5×10^4 TO 5×10^7 RAD
M. H. Van de Voorde 9 May 1967 24 p refs
(CERN-67-14)

When the decrease due to irradiation of the average molecular weight of polymethylmethacrylate is known, the dose absorbed can be calculated. The change in molecular weight was measured by an Ubbelohde viscometer. Benzene, chloroform and acetone were used as solvents. The reported range is from about 5×10^4 to 5×10^7 rad, and the accuracy of this dosimeter is within 10%. This dosimeter was compared with a Fricke dosimeter, an ionization chamber, and a calorimeter, which were used during irradiation by a cobalt source, spent fuel rods, a linear electron accelerator, and a nuclear reactor, respectively. The viscometric dosimeter provides a direct method for the determination of the total energy absorbed in the mixed radiation field around accelerators. However, the method is not simple and is time-consuming, thus making it not generally suitable for routine use. It does approach the goal of absolute dosimetry, however, and is particulary useful for the calibration of other dosimeters. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N67-34001# Oak Ridge National Lab., Tenn. Technical Information Div.
THE RESULTS OF ULTRASONIC TESTING IN THE PRACTICE OF MACHINE AND BOILER CONSTRUCTION CONCERNING THE MATERIAL AND STRENGTH PROPERTIES OF COMPONENTS
Hans-Juergen Meyer (Ph.D. Thesis—Tech. Hochschule) 1965 222 p refs Transl. into ENGLISH from GERMAN
(ORNL-TR-1369) CFSTI: HC $3.00/MF $0.65

Information from nondestructive ultrasonic testing is related to the material properties and to the mechanical properties of components. New methods of using ultrasonic tests are explained, which not only find defects in the usual sense but also obtain information about material properties that otherwise could only be obtained by destructive testing. In testing turbine rotor forgings, inclusions of certain sizes and shapes are not important in operation or for safety, but in turbine blades, hidden cracks can influence stress and operational behavior. Defects found in boiler tubes were investigated as to strength behavior. A "defect area value" has been introduced which relates ultrasonic screen indications, damage to tubes, and reduced ductility. The ratio of bond echo and back surface echo is a useful measure of bond strength. This ratio provides a criterion for the practical ultrasonic inspection of bearings. The different behavior of sound waves during diffusion into material is used to determine material strength on which material behavior depends. Reasons for damage can be explained and ideas for new designs to minimize damage can be obtained through ultrasonic testing. NSA

N67-34091 Metaalinstituut TNO, Delft (Netherlands).
OPTIMUM CONDITIONS FOR BLAST CLEANING OF STEEL PLATE [OPTIMALE CONDITIES VOOR HET REINIGEN VAN STAHLPLAAT DOOR STRALEN]
J. Remmelts Netherlands Res. Centre TNO for Shipbldg. and Navigation, Apr. 1967 21 p refs
(Rept.-94C; TDCK-48334) CFSTI: HC $3.00

Technological investigations are described in which a laboratory set-up simulates conditions of practice when blast cleaning steel plate as well as possible. The rate of cleaning is found to increase when more abrasive per unit of time is discharged. This means that high pressure, a large nozzle and a wide valve for metering the abrasive flow are advantageous, but the actual setting of these variables should be mutually adjusted. The optimum blasting angle for removing millscale is about 45°, and the optimum nozzle to work distance 55–75 cm. The smaller the abrasive grains, the quicker the cleaning process. Air consumption decreases as, under otherwise constant conditions, the abrasive transport is increased. High cleaning rates are advantageous, because they lead to lower costs per m^2 for labour and power, whilst costs for abrasive hardly go up. Author

N67-34111# Institute for Defense Analyses, Arlington, Va.
SERVOMECHANISM-PROPELLED VEHICLES
William E. Bradley Jun. 1967 26 p
(Contract DAHC15-67-C-0011)
(P-314; AD-653835) CFSTI: HC $3.00/MF $0.65

The report discusses the potential utility and feasibility of novel modes of ground transportation suitable for rough terrain. More specifically, it discusses the possibility of using servomechanism propelled walking machines, describing the components of a hypothetical quadruped vehicle as a speculative example, and touching briefly on some design ideas for bipeds and hexapeds. A final section offers some discussion of the efficiency of hydraulic servomechanism propelled vehicles. Author (TAB)

N67-34194# Bunker-Ramo Corp., McLean, Va.
TESTING FOR COMPLIANCE WITH RELIABILITY SPECIFICATIONS. A COST–TIME–EFFECTIVENESS PROBLEM
J. C. Grimberg 20 Sep. 1966 29 p ref
(Contract DA-36-039-AMC-00954(Y))
(Rept.-06-06-01; AD-652691) CFSTI: HC $3.00/MF $0.65

The purpose of this technical report is to discuss the problem of testing for reliability as a product quality feature, both for acceptance and assurance of reliability measurements, for the case of one-of-a-kind products when uninterrupted operations is a very important consideration. The introduction discusses this problem as distinct from the quantity production case and presents the need for product quality assurance. Under definition of terms, working concepts are presented and reliability is singled out as the principal

contributor towards product quality. The ability of the product to meet designated quality requirements or its reliability is dependent principally upon the products design. Any deviation from the products designated quality due to manufacturing/assembly deficiencies can be taken care of by a quality control/zero defects program. Any deviations due to aging problems are predictable and can be solved by maintenance. The reliability of the product is not considered affected by these latter two causes manufacturing/assembly or aging effects. TAB

N67-34323 Technisch Physische Dienst TNO-TH, Delft (Netherlands).
TESTING OF WELDED AND BONDED JOINTS FOR ACOUSTIC SCALE MODELS [ONDERZOEK VAN LASEN LIJMVERBINDINGEN VOOR A KOESTISCHE SCHAAL-MODELLEN]
T. ten Wolde and W. H. Sinte Maartensdijk 31 May 1967 37 p refs In DUTCH
(Rept.-708.132; TDCK-48093)

In order to construct scale models of ships for measuring acoustic properties, it is necessary to weld 1-mm-thick steel plate with continuous seams. This is difficult and sometimes impossible, since the welded joints will not be to scale and thus fail to represent accurately the acoustic conditions of the full scale vessel. Several bonding agents and methods were tested and evaluated for their suitability as welding substitutes. Comparative acoustic tests were conducted with variously welded and glued joints on scale models and on welded joints of full scale joint sections of ships. The bonded joints that were found to be acceptable representations of the welded joints are listed in tables. Transl. by K.W.

N67-34390*# Boeing Co., Seattle, Wash. Space Div.
IDENTIFYING OPTIMUM PARAMETERS OF HOT EXTRUSIONS Progress Report, 1 May–13 Jul. 1967
13 Jul. 1967 26 p refs
(Contract NAS7-276)
(NASA-CR-87491) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Several single crystals of MgO were hot forged (or compressed) in order to reduce grain size prior to extrusion. Though requiring higher temperatures, and being prone to fracture, dense hot pressed and fired (for purification) MgO billets can also be forged. Observations on the latter indicate no texturing occurs from forging, but that residual porosity is often associated with substructure. A postulate is offered to explain how increasing annealing, which decreases surface work hardening, may cause a rise in strength scatter. Author

N67-34438# Sandia Corp., Albuquerque, N. Mex.
THE THREE PLANE CONCEPT
R. O. Dell Apr. 1967 21 p Presented at the 6th Meeting of the Intern. Stds. Organ. and Transportation Corps Drawings, Moscow, Jun. 1967
(Contract AT(29-1)-789)
(SC-DC-67-1745; CONF-670603-1) CFSTI: HC $3.00/MF $0.65

The Three Plane Concept of making engineering drawings more mathematically and geometrically precise specifies on a drawing the relationship of the part and its features to a reference framework of three mutually perpendicular planes. This method enables the designer to establish common origin for measurements for all users in the manufacturing and inspection operations thereby ensuring a uniform interpretation as they execute their individual functions. The method facilitates the use of the drawing wherever programming is required for the manufacture of a part by numerically controlled equipment. NSA

N67-34467# Army Materials Research Agency, Watertown, Mass.
DEFENSE CONFERENCE ON NONDESTRUCTIVE TESTING
1966 187 p refs Minutes of the 15th Ann. Meeting held 4–6 Oct. 1966
(AD-649692) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. PROBLEM 1—SEPARATION OF BASE ADAPTER FROM 81mm MORTAR SHELL J. G. Barr (Frankford Arsenal) p 3–8 (See N67-34468 20-15)
2. PROBLEM 2—A PROBLEM IN THE NONDESTRUCTIVE TESTING OF TORPEDO PARTS J. G. Turbitt (Naval Torpedo Sta.) p 9–14 (See N67-34469 20-15)
3. PROBLEM 3—NDT OF M149, 400 GALLON WATER TANK D. L. Gamache p 15-28 (See N67-34470 20-15)
4. PROBLEM 4—ULTRASONIC CRACK-DEPTH ESTIMATION IN HIGH STRENGTH STEEL AND TITANIUM STRUCTURAL WELDMENTS S. Goldspiel, G. Di Giacomo, and A. L. Chick (Naval Applied Sci. Lab.) p 29–40 (See N67-34471 20-15)
5. PROBLEM 5—DUCTILITY OR ELONGATION DETERMINATION OF SINTERED IRON ROTATING BANDS FOR ARTILLERY SHELL D. J. Molella (Picatinny Arsenal) p 41–48 (See N67-34472 20-15)
6. PAPER 1—EDDY CURRENT INSPECTION OF TURBOJET ENGINE TURBINE DISKS FOR LOSS OF STRENGTH L. G. Marler (Oklahoma City Air Materiel Area) p 49–55 (See N67-34473 20-28)
7. PAPER 2—MICROWAVE NONDESTRUCTIVE TESTING T. M. Lavelle (Frankford Arsenal) p 57–67 (See N67-34474 20-15)
8. PAPER 3—INFRARED MULTIPLE-SCAN BOND INSPECTION SYSTEM P. E. J. Vogel p 69–75 ref (See N67-34475 20-14)
9. PAPER 4—AN IMPROVED METHOD FOR INSPECTING SOLDER CONNECTIONS S. Washington (Picatinny Arsenal) p 77–99 refs (See N67-34476 20-15)
10. PAPER 5—NEUTRON RADIOGRAPHY TO DETERMINE THE CONDITION OF THE CHARGE IN EXPLOSIVE DEVICES H. Heffan p 101–109 (See N67-34477 20-15)
11. PAPER 6—NONDESTRUCTIVE INSPECTION OF ADHESIVE BONDED METAL HELICOPTER ROTOR BLADES R. T. Lennon and C. R. Warg (Defense Contract Administration Ser.) p 111–128 (See N67-34478 20-15)
12. PAPER 7—THE USE OF INDUSTRY DOCUMENTS BY THE GOVERNMENT T. E. Dunn, Jr. p 129–131 (See N67-34479 20-34)
13. NONDESTRUCTIVE TESTING IN THE AIR FORCE W. F. Bennett (San Antonio Air Materiel Area) p 135–152 (See N67-34480 20-15)
14. REPORT 1—QUALITY ASSURANCE TESTING OF METAL TO METAL BONDING FOR AIRCRAFT STRUCTURES E. Lemaster (Boeing Co.) p 155–159 (See N67-34481 20-15)
15. REPORT 2—AN ULTRASONIC METHOD FOR MEASURING THE THICKNESS OF NOSE CONE ANNULI L. C. Cardinal (Naval Res. Lab.) p 161–166 (See N67-34482 20-15)

N67-34468# Frankford Arsenal, Philadelphia, Pa.
PROBLEM 1—SEPARATION OF BASE ADAPTER FROM 81mm MORTAR SHELL
John G. Barr *In* Army Mater. Res. Agency Defense Conf. on Nondestructive Testing 1966 p 3–8 (See N67-34467 20-15)

For improved 81mm H.E. M374 metal parts product reliability, and in an effort to prevent separation at joints of ammunition, an investigation was conducted to find a reliable inspection technique to replace the destructive type peel test presently employed. The shell body material mentioned is cast pearlitic malleable iron, while the base adapter material is AISI 1018 steel. A sectionalized assembly of the shell body and base adapter is shown. R.U.

N67-34469# Naval Torpedo Station, Keyport, Wash.
PROBLEM 2—A PROBLEM IN THE NONDESTRUCTIVE TESTING OF TORPEDO PARTS
J. G. Turbitt *In* Army Mater. Res. Agency Defense Conf. on Nondestructive Testing 1966 p 9–14 (See N67-34467 20-15)

Quality assurance was studied in the nondestructive testing of torpedo parts. X-ray testing was used to examine the welds of Warhead Mark 37 and Exercise Head Mark 64. Schematics depict pertinent parts inspected. R.U.

N67-34470# Army Tank-Automotive Center, Warren, Mich.
PROBLEM 3—NDT OF M149, 400 GALLON WATER TANK
David L. Gamache *In* Army Mater. Res. Agency Defense Conf. on Nondestructive Testing 1966 p 15–28 (See N67-34467 20-15)

The nondestructive detection of defects in urethane foam insulation bonded to fiber glass panels is briefly outlined. Defects in the M149, 400-gallon water tank include large gas pockets or voids in the foam and lack of adhesion between the foam and panels. No solution was found to meet all inspection and utilization requirements for the tanks. R.U.

N67-34471# Naval Applied Science Lab., Brooklyn, N. Y.
PROBLEM 4—ULTRASONIC CRACK-DEPTH ESTIMATION IN HIGH STRENGTH STEEL AND TITANIUM STRUCTURAL WELDMENTS
S. Goldspiel, G. Di Giacomo, and A. L. Chick *In* Army Mater. Res. Agency Defense Conf. on Nondestructive Testing 1966 p 29–40 (See N67-34467 20-15)

In application to fabricating high yield steel and titanium weldments for submersible hull and pressure vessel structures, ultrasonic crack-depth estimation and other nondestructive tests were conducted. Neither NDT method could perfectly agree with the depth determined by destructive means. R.U.

N67-34472# Picatinny Arsenal, Dover, N. J.
PROBLEM 5—DUCTILITY OR ELONGATION DETERMINATION OF SINTERED IRON ROTATING BANDS FOR ARTILLERY SHELL
Domenic J. Molella *In* Army Mater. Res. Agency Defense Conf. on Nondestructive Testing 1966 p 41–46 (See N67-34467 20-15)

Visual inspection and destructive tensile and ductility tests were used to determine the ductility of elongation of rotating band blanks for artillery shells. The ductility requirement is significant in that it must be capable of being properly seated into the shell band seat without cracking. A highly reliable, economical nondestructive test method which will replace present tests is considered highly desirable. R.U.

N67-34474# Frankford Arsenal, Philadelphia, Pa.
PAPER 2—MICROWAVE NONDESTRUCTIVE TESTING
Theresa M. Lavelle *In* Army Mater. Res. Agency Defense Conf. on Nondestructive testing 1966 p 57–67 (See N67-34467 20-15)

A laboratory test program was initiated to investigate the possibility of applying microwave techniques to nondestructive testing of dielectric materials. Microwave techniques because of their basic characteristics of reflection, scattering, absorption, and transmission by any non-metal are utilized in the test program to measure or detect thickness. The technique was successful in measuring thickness to a resolution of .0393 inch in six inches of epoxy resin. Density changes, cylindrical flaws, and spherical glass beads were also detected. R.U.

N67-34476# Picatinny Arsenal, Dover, N. J.
PAPER 4—AN IMPROVED METHOD FOR INSPECTING SOLDER CONNECTIONS
Shelton Washington *In* Army Mater. Res. Agency Defense Conf. on Nondestructive Testing 1966 p 77–99 refs (See N67-34467 20-15)

For possible military applications, effort was directed toward developing a nondestructive technique to inspect solder connections. The feasibility was studied of applying a nondestructive testing technique to solder connections which would indicate whether or not heat was properly applied, and therefore the instant and future condition of the joint. The nondestructive test involves the use of a soft solder composition with a suitable phosphor having the desired thermal-luminescence qualities to make ultraviolet examination of the solder joint a useful indication of its mechanical and electrical performance at the time of inspection and at future times. If the flux residue around the joint fluoresces under ultraviolet light, this is a positive indication of insufficient heating. Use of this technique in production will allow the inspection of assemblies rather than individual soldered connections, reducing inspection man-hours substantially. R.U.

N67-34477# Naval Weapons Station, Concord, Calif.
PAPER 5—NEUTRON RADIOGRAPHY TO DETERMINE THE CONDITION OF THE CHARGE IN EXPLOSIVE DEVICES
Howard Heffan *In* Army Mater. Res. Agency Defense Conf. on Nondestructive Testing 1966 p 101–109 (See N67-34467 20-15)

Along with the increasing application of explosive loaded devices and assemblies in missiles and space components, where one-shot reliability is of paramount importance, has developed the requirement for nondestructive examination of the low density explosive materials sealed in metal cases. In recent studies of the applicability of nondestructive test methods for the POLARIS Missile EBW Detonator, containing powdered Pentaerythrite Tetranitriate (PETN), neutron radiography demonstrated the ability to show slight separations, density changes, recrystallization, and moisture in the charge. The technique used neutrons from the 30 KW Nuclear Test Reactor of the General Electric Vallecitos Atomic Power Laboratory, commercial X-ray film, and a back gadolinium screen. Further application of neutron radiography to explosive cord assemblies, conventional ammunition primers, detonators, and other loaded items in which the steel, brass, or lead case prevents application of any other nondestructive test method, shows that neutron radiography can satisfy the need for a sensitive examination. Author

N67-34478# Defense Contract Administration Services, Rochester, N. Y.
PAPER 6—NONDESTRUCTIVE INSPECTION OF ADHESIVE BONDED METAL HELICOPTER ROTOR BLADES
Richard T. Lennon and Clifford R. Warg *In* Army Mater. Res. Agency Defense Conf. on Nondestructive Testing 1966 p 111–128 (See N67-34467 20-15)

The helicopter blade assemblies manufactured for the UH-1 helicopter are adhesive bonded units. All elements of the blade are bonded together into one homogeneous unit free from rivets, bolts or other external protrusions. When finished, however, these blades do not lend themselves to typical inspection methods to determine the adequacy of the bonding process relative to complete bonding. Two nondestructive inspection methods were selected which have proven to be reliable, namely, Ultrasonic Immersion

Testing, and Manual Tapping. Details of these two inspection methods are presented together with a description of the equipment used. Blade materials, manufacturing methods, quality characteristics, acceptance criteria and test techniques and related problems are described. Author

N67-34480# San Antonio Air Materiel Area, Kelly AFB, Tex.
NONDESTRUCTIVE TESTING IN THE AIR FORCE
William F. Bennett *In* Army Mater. Res. Agency Defense Conf. on Nondestructive Testing 1966 p 135–152 (See N67-34467 20-15)

Service inspection of the field maintenance of weapons systems in addition to nondestructive testing in the Air Force are summarized. Emphasis on the inspection and maintenance activities is due to the major cost factor in the operation of weapons system. The nondestructive inspection program provides the following equipment at a typical A.F. base: borescopes, magnifiers for optical method, penetrant kit and black light, conductivity meter for eddy current, magnetic particle mobile and portable units, pulse echo ultrasonic inspection unit, portable X-ray radiography equipment, oscilloscope and polaroid camera. The program is geared to maximum avoidance of remove and replace operations. R.L.I.

N67-34481# Boeing Co., Wichita, Kans. Airplane Div.
REPORT 1—QUALITY ASSURANCE TESTING OF METAL TO METAL BONDING FOR AIRCRAFT STRUCTURES
Edmond Lemaster *In* Army Mater. Res. Agency Defense Conf. on Nondestructive Testing 1966 p 155–159 (See N67-34467 20-15)

Summary remarks are presented on the fabrication and inspection of bonded structures, and on reliability testing of metal-to-metal bonding. The practive of preparing test specimens is mentioned as a way to eliminate the need for destructive testing. The nondestructive X-ray, ultrasonic, and sonic methods of obtaining data on the quality, integrity, and reliability of finished products are discussed in terms of the cost factor saving. Methods involving infrared radiation systems, and liquid crystals are also cited as quality assurance techniques. R.L.I.

N67-34482# Naval Research Lab., Washington, D. C.
REPORT 2—AN ULTRASONIC METHOD FOR MEASURING THE THICKNESS OF NOSE CONE ANNULI
Louis C. Cardinal *In* Army Mater. Res. Agency Defense Conf. on Nondestructive Testing 1966 p 161–166 (See N67-34467 20-15)

The need of a method to measure the thickness of proximity-fuse, molded-polyethylene, nose cone annuli to within ± 0.005 inches is discussed. Test procedures, equipment calibration, and the inspection technique are outlined. It is considered feasible to use ultrasonics to measure the thickness of the annulus of a polyethylene nose cone to the specified accuracy provided the proper techniques are observed. Standard equipment and a jig used in making these measurements are depicted. It required approximately one minute to inspect a nose cone. R.L.I.

N67-34490*# Electro-Optical Systems, Inc., Pasadena, Calif.
RESEARCH AND DEVELOPMENT OF MAGNESIUM/ALUMINUM ELECTROFORMING PROCESS FOR SOLAR CONCENTRATORS Final Report, 13 May 1966–10 May 1967
K. Lui, R. Guidotti, and M. Klein May 1967 89 p refs
(Contract NAS1-6218)
(NASA-CR-66427) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Studies to optimize organic solvent plating baths for the deposition of aluminum and magnesium were conducted. The program was divided into electrotechnology studies, process development, and electroforming studies. High purity aluminum and was electroformed from a mixed ether bath of aluminum chloride and lithium aluminum hydride which showed potentially useful structural characteristics. The effects of current density bath impurities and various solvent and salt additions were studied. The aluminum electroforming process was scaled up and an aluminum paraboloid mirror, 30.5 centimeters, was electroformed to demonstrate the bath's practicability. Author

N67-34534 Joint Publications Research Service, Washington, D. C.
WELDING GRAPHITE MATERIALS
N. L. Kareta and N. N. Nefedov 15 Aug. 1967 8 p refs Transl. into ENGLISH from Avtomat. Svarka (Kiev), no. 1, Jan. 1967 p 56–58
(JPRS-42228; TT-67-32858) CFSTI: $3.00

Melting and diffusion welding of graphite materials does not result in joint strengths that meet practical strength requirements. By using zirconium strips during diffusion welding, however, graphite joints that were equal in strength to the base material were obtained for short periods of loading at temperatures up to 2500°C. Details are included for the electric arc welding of graphite with a consumable graphite electrode and for the diffusion welding processes used. M.W.R.

N67-34561# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHEMICAL AND CHEMICAL TECHNOLOGY. PART II: TRANSACTIONS Selected Articles
23 Dec. 1966 25 p refs Transl. into ENGLISH from Tr. Khimiko-Tekhnol. Inst. (USSR), No. 16, 1963 p 181–188, 193–201 (FTD-HT-66-373; TT-67-62093; AD-653504) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. MODERN METHODS OF INVESTIGATING LIQUID FRICTION BEARINGS WORKING IN AGGRESSIVE MEDIA L. I. Mamon and D. V. Galivets p 1–9 refs (See N67-34562 20-15)

2. DETERMINING THE MECHANICAL PROPERTIES OF METAL OF WELDED LOW ALLOYED SEAMS BY THEIR CHEMICAL COMPOSITION B. D. Lebedev p 10–20 refs (See N67-34563 20-12)

N67-34562# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MODERN METHODS OF INVESTIGATING LIQUID FRICTION BEARINGS WORKING IN AGGRESSIVE MEDIA
L. I. Mamon and D. V. Galivets *In its* Chem. and Chem. Technol. Pt. II: Trans. 23 Dec. 1966 p 1–9 refs (See N67-34561 20-15)

The wear of metals in an aggressive medium was investigated using a special laboratory friction machine designated as the X2-M. This machine permits carrying out investigations on the friction of a solid disk or metal, whereby, the sample is submerged in a liquid medium bath. The study of slide bearing operation was made in 92% sulfuric acid. It was established that the medium appears to be the basic factor reducing the surface hardness. Author

N67-34619# Marine Engineering Lab., Annapolis, Md.
BEARING MATERIALS FOR WATER LUBRICATION
Paul Lagally Mar. 1967 34 p refs
(MEL-103/67; AD-654177) CFSTI: HC $3.00/MF $0.65

Isotectic polybutene in contact with a bronze journal was investigated as a bearing material combination for water lubrication.

Aliphatic alcohols were used as model substances for protonic lubricants. The fact that even methanol is a better lubricant than water, in spite of its lower viscosity, is attributed to the lower degree of association. Stick-slip motions indicate boundary lubrication of varying degree. Although polybutene compares favorably with many other organic bearing materials, results of this study indicate that wettability with water is a requirement for further improvement. New bearing material designs for water lubrication are proposed. Author (TAB)

N67-34844# Aberdeen Proving Ground, Md. Army Coating and Chemical Lab.

A STUDY OF THE OPERATING LIMITS OF THE STANNATE IMMERSION BATH Final Report

William H. Deaver May 1967 12 p refs

(CCL-230; AD-652572) CFSTI: HC $3.00/MF $0.65

A study was conducted to determine the operating limits of the stannate immersion process for minimizing galvanic corrosion of magnesium-steel couples. Salt spray tests on specimens treated and then painted indicated that 100 sq. feet of work containing up to 22 percent steel could be safely processed per gallon of bath before substandard coatings were produced. Magnesium steel couples containing more than 22 percent steel would not receive a satisfactory stannate coating. Author (TAB)

N67-34698# General Electric Co., Schenectady, N. Y. Research and Development Center.

POROUS BODIES OF TANTALUM, NIOBIUM, AND ALUMINUM FABRICATED BY METAL-SPRAY PROCESSES

J. R. Rairden Sep. 1966 5 p refs

(Rept.-66-C-318)

Free-standing, porous bodies of high-purity tantalum, niobium, and aluminum can be fabricated by plasma arc spraying powders in an argon atmosphere. Porosity in these bodies is achieved by using a long gun-to-mandrel distance. The "available" surface area of these porous materials is shown to be comparable to those obtained by powder pressing and sintering techniques. Porous aluminum also can be fabricated by using a wirefeed metallizing gun. Author

N67-34717# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.

A HYDRODYNAMIC MODEL FOR COLD STRIP ROLLING

D. S. Bedi and M. J. Hillier [1967] 35 p refs CFSTI: HC $3.00/MF $0.65

The theory of rolling is modified to allow calculation of a hydrodynamic film thickness and viscous friction coefficient using Reynold's equation for the lubricant. Calculations are made for the case where the fluid film covers the arc of contact. The film thickness is assumed uniform and is determined by the principle of minimum rate of entropy production. It is shown that the apparent coefficient of friction varies significantly over the arc of contact. At small reductions the roll load tends to decrease with speed of rolling, while at high reductions the load tends to increase. The point of maximum roll pressure does not coincide with the neutral plane; and under certain rolling conditions there may be no maximum in the pressure over the arc of contact. Author

N67-34785# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

MAGNETIC FORCE WELDING APPLICATIONS AT BATTELLE NORTHWEST

R. F. Boolen May 1967 18 p

(Contract AT(45-1)-1830)

(BNWL-422) CFSTI: HC $3.00/MF $0.65

The use of magnetic force welding for materials in the ferrous, Ni-base, reactive, and refractory metal categories is discussed. Graphite was also successfully welded by the process. A partial list of the materials that have been studied is given. The micro-structures of cross sectional weld areas in a representative selection of the listed materials are illustrated. The potential of magnetic force welding is also discussed. NSA

N67-34828# Reactive Metals, Inc., Ashtabula, Ohio. Extrusion Plant.

[URANIUM FABRICATION] Annual Progress Summary, 1966

R. L. Bean 20 Apr. 1967 100 p refs

(Contract AT(30-1)-1405)

(RMI-8) CFSTI: HC $3.00/MF $0.65

Progress is reported on upset-forging of NPR-NOE billets, precision extrusion of U, heating salt evaluation, small-hole tube feasibility study, ultrasonic measurements investigations, and plant assistance projects. NSA

N67-34874 Joint Publications Research Service, Washington, D. C.

HUNGARIAN RESEARCH RESULTS IN DEVELOPMENT OF COOLING-LUBRICATING FLUIDS FOR METAL WORKING

Zoltan Toth 13 Jul. 1967 25 p Transl. into ENGLISH from Gepgyartastechnol. (Budapest), v. 7, no. 5, May 1967 p 219-227

(JPRS-41817; TT-67-32449) CFSTI: $3.00

Research focusing on improving the properties of commercial mineral oil emulsions, the development and preparation of new emulsions for industrial metal working applications, and the development of control methods for measuring the properties of cooling and lubricating fluids; is reported. Significant findings of these studies are: (1) abietic acid emulsions, sulfonated castor oils, and non-ionic emulsions can be used industrially as cooling and lubricating fluids; (2) chloride, sulfur, and phosphorous additives in oils or in their aqueous mixtures can be used with good results under the most critical conditions; and (3) sulfide-containing fluids can be used for thread cutting, boraching, and long hole drilling with good results. Also reported is the development of a metal working inspection process which was used in the classification of emulsions under study. S.C.W.

N67-34957# Sandia Corp., Albuquerque, N. Mex.

PROJECTED TOLERANCE ZONE CONCEPT

P. A. Nicovich Mar. 1967 13 p Presented at the 6th Meeting of the Intern. Std. Organ. and Transportation Corps Drawings, Moscow, Jun. 1967

(Contract AT(29-1)-789)

(SC-DC-67-1744; CONF-670803-2) CFSTI: HC $3.00/MF $0.65

The projected tolerance zone concept as a new and proven method for controlling the position and attitude of threaded holes is recommended for further study and consideration. It has been shown that the conventional method of applying positional tolerances to threaded holes does not always ensure proper assembly of parts or guarantee interchangeability. In this case, the precept of allowing total variation of threaded hole axis within a tolerance zone located below the mating surface is detrimental to design intent. Interferences can occur which do not allow the engaging fastener to enter the threaded hole at assembly. By simply projecting the tolerance zone a specified height above the mating surface, these interferences can be carefully avoided. Author (NSA)

N67-35007*# Battelle Memorial Inst., Columbus, Ohio.
PACKAGING AND PRESERVATION OF SPACE-VEHICLE HARDWARE Final Report, 9 Jun. 1966–8 Jun. 1967
C. W. Cooper, J. Mason Pilcher, J. A. Gieseke, A. R. Bunk, and W. E. Clark 9 Jul. 1967 107 p refs
(Contract NAS8-20317)
(NASA-CR-87419) CFSTI: HC $3.00/MF $0.65 CSCL 13D

This study of the packaging and preservation of space-vehicle hardware is divided into three phases—criteria control and standards, material development and application, and development of new procedures using the new materials cleaned under the new standards. The first segment of the effort which included contacts with major suppliers and users of clean packaging materials as well as an analysis of relevant specifications and standards resulted in recommendations for the preparation of any future standards. One critical shortcoming of all currently existing standards is the omission of any means for qualifying a material on the basis of its more important single property—slough resistance. Other portions of the study are concerned with evaluation of new materials and recommendations for preferred packaging systems. Materials were found which are superior in abrasion resistance to the presently preferred Nylon 6. A polycarbonate film was the best of these. Composites employing this material as well as various combinations of polyester film, polyvinyl fluoride, a polyvinylidene chloride copolymer, and fluorohalo polymers are suggested. Author

N67-35101# Israel Program for Scientific Translations, Ltd., Jerusalem.
HYGIENE EFFECTS AND CONTROL OF DUSTS, FOGS, GASES, VAPORS, RADIOACTIVE PARTICLES
H. Schneider, ed. 1966 77 p refs Transl. into ENGLISH from VDI (Ver. Deut. Ingr.) Z. (Dusseldorf), v. 26, no. 11, Nov. 1966
CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. DUST PROPERTIES WHICH AFFECT SEPARATION J. Tuma p 1–6 refs (See N67-35102 20-15)

2. STATISTICAL OBSERVATIONS ON THE EFFICIENCY OF ELECTROSTATIC PRECIPITATORS S. Masuda p 6–11 refs (See N67-35103 20-15)

3. CONDITIONING OF BOILER FLUE GASES FOR IMPROVING EFFICIENCY OF ELECTROFILTERS K. Darby and D. O. Heinrich p 12–17 refs (See N67-35104 20-15)

4. DERIVING A FUNCTION TO PREDICT SEPARATION EFFICIENCY OF DYNAMIC WET SCRUBBERS V. Quitter p 17–23 refs (See N67-35105 20-15)

5. FEED GAS CLEANING IN COKE-OVEN LARRY CARS. A CONTRIBUTION TO THE WET SEPARATION OF DUSTS L.-h. Engels p 23–31 refs (See N67-35106 20-15)

6. A NEW VENTURI SCRUBBER TO SEPARATE DUST PARTICLES $<1\mu$, ESPECIALLY OF BROWN SMOKE O. Storch p 32–34 (See N67-35107 20-15)

7. THE DUST SITUATION AT MIXING PLANTS USED IN BITUMINOUS ROAD CONSTRUCTION IN WESTERN GERMANY E. Walter p 34–40 refs (See N67-35108 20-15)

8. SOME REASONS FOR UNSATISFACTORY OPERATION OF DUST-REMOVAL PLANTS R. Pistor p 41–44 (See N67-35109 20-15)

9. DUST CONTROL DURING QUARRYING AND WORKING OF STONE K. Getsburger p 45–50 refs (See N67-35110 20-15)

10. STONEWORKING WITH PNEUMATIC TOOLS AND DUST CONTROL V. Koelm p 50–53 refs (See N67-35111 20-15)

N67-35102# Israel Program for Scientific Translations, Ltd., Jerusalem.
DUST PROPERTIES WHICH AFFECT SEPARATION
Jiri Tuma *In its* Hyg. Effects and Control of Dusts, Fogs, Gases, Vapors, Radioact. Particles 1966 p 1–6 refs (See N67-35101 20-15)

The identification of dust properties which affect the design of dust collectors, and methods for measuring these properties and the particle size are investigated. It is pointed out that the geometrical shape is of primary importance for screen analysis and microscopy; hydrodynamic properties for liquid sedimentation, air screening, and centrifugal screening; and optical properties for nephelometry and extinction measurement with light. Supplementing particle size analysis by microphotography is mentioned. Instrumentation and techniques for measuring the electric resistance of precipitated dusts, shaking properties, adhesion, wettability, and abrasive behavior are described, and typical results are presented. Difficulties connected with planning dust collectors are indicated. N.E.N.

N67-35103# Israel Program for Scientific Translations, Ltd., Jerusalem.
STATISTICAL OBSERVATION ON THE EFFICIENCY OF ELECTROSTATIC PRECIPITATORS
Senichi Masuda *In its* Hyg. Effects and Control of Dusts, Fogs, Gases, Vapors, Radioact. Particles 1966 p 6–11 refs (See N67-35101 20-15)

A statistical discussion is presented for the design of electrostatic precipitators considering the separation efficiency and its guaranteed attainment. The variables are identified, and the safety factor effects are discussed. Examples of the statistical design are given, and a design chart is included. N.E.N.

N67-35104# Israel Program for Scientific Translations, Ltd., Jerusalem.
CONDITIONING OF BOILER FLUE GASES FOR IMPROVING EFFICIENCY OF ELECTROFILTERS
Kenneth Darby and Dieter O. Heinrich *In its* Hyg. Effects and Control of Dusts, Fogs, Gases, Vapors, Radioact. Particles 1966 p 12–17 refs (See N67-35101 20-15)

The electric characteristics of the precipitators and the addition of small quantities of SO_3 for increasing the collecting efficiency are discussed. The equipment for SO_3 conditioning and the economic aspects are described. Effective migration velocities were found to be increased by up to 85% in full scale plants, with no increase in sulfur emission or corrosion. N.E.N.

N67-35105# Israel Program for Scientific Translations, Ltd., Jerusalem.
DERIVING A FUNCTION TO PREDICT SEPARATION EFFICIENCY OF DYNAMIC WET SCRUBBERS
Volker Quitter *In its* Hyg. Effects and Control of Dusts, Fogs, Gases, Vapors, Radioact. Particles 1966 p 17–23 refs (See N67-35101 20-15)

Efficiency measurements were carried out in an experimental wet-separation plant. It was found that separation efficiency is influenced by moisture content, fineness of droplets, particle size and density of dust, wetting method, and separation method. A separation formula is derived from the measuring results according to the statistical method. Author

N67-35106# Israel Program for Scientific Translations, Ltd., Jerusalem.
FEED GAS CLEANING IN COKE-OVEN LARRY CARS. A CONTRIBUTION TO THE WET SEPARATION OF DUSTS
Lothar-H. Engels *In its* Hyg. Effects and Control of Dusts, Fogs, Gases, Vapors, Radioact. Particles 1966 p 23–31 refs (See N67-35101 20-15)

The problem of feed gas cleaning in coking plants is outlined. After a description of technological processes occurring in coal carbonization, various methods for gas removal and gas cleaning are shown. Especially difficult operating conditions and the problem of output measurements to assess the efficiency of the method used are also discussed. Factors influencing the efficiency of known dust cleaning methods (size and design of oven, type and composition of coal etc.), and the measuring results available are considered. Finally, the costs of investment, maintenance, and operation are given. Author

N67-35107# Israel Program for Scientific Translations, Ltd., Jerusalem.
A NEW VENTURI SCRUBBER TO SEPARATE DUST PARTICLES – 1α, ESPECIALLY OF BROWN SMOKE
Otakar Storch *In its* Hyg. Effects and Control of Dusts, Fogs, Gases, Vapors, Radioact. Particles 1966 p 32–34 (See N67-35101 20-15)

A new Venturi separator is described which is particularly suitable for separating dust occurring in metallurgical works. The separator design is very simple and all units of this type have a constant separation efficiency regardless of size. The water required can have a solid content up to 100 g/l which considerably decreases the costs of sludge treatment. Author

N67-35108# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE DUST SITUATION AT MIXING PLANTS USED IN BITUMINOUS ROAD CONSTRUCTION IN WESTERN GERMANY
Erwin Walter *In its* Hyg. Effects and Control of Dusts, Fogs, Gases, Vapors, Radioact. Particles 1966 p 34–40 refs (See N67-35101 20-15)

Extensive investigations gave information on the amount of dust produced in different working places, from mixing plants to road construction using bitumen. It is shown that workers not only employed in plants using silica are exposed to silicosis hazards, but also when additives containing silica are used. This is also valid for basaltic rocks or blast furnace slag. As a result of dust emission, according to type of rock, dust hazards can also exist in the environment of a plant. By taking special measures in the selection of plant sites and chimney heights, by adapting the throughput to the efficiency and capacity of dust removal plants, and particularly by selecting raw material, it is possible, to a large extent, to reduce any serious effects. Machinery and technology also require the use of new methods. Author

N67-35109# Israel Program for Scientific Translations, Ltd., Jerusalem.
SOME REASONS FOR UNSATISFACTORY OPERATION OF DUST-REMOVAL PLANTS
Rudolf Pistor *In its* Hyg. Effects and Control of Dusts, Fogs, Gases, Vapors, Radioact. Particles 1966 p 41–44 (See N67-35101 20-15)

Investigations on the causes of unsatisfactory dust removal show that all aspects of planning, design, production, and delivery to a plant must be carefully evaluated. In the first place, the operating conditions must be clearly determined. It is explained by practical examples what difficulties can still occur and how they can be eliminated. Author

N67-35110# Israel Program for Scientific Translations, Ltd., Jerusalem.
STONEWORKING WITH PNEUMATIC TOOLS AND DUST CONTROL
Karl Getsburger *In its* Hyg. Effects and Control of Dusts, Fogs, Gases, Vapors, Radioact. Particles 1966 p 45–50 refs (See N67-35101 20-15)

Instruments are described for determination of dust in places in which it is produced, and measures are discussed which could be taken to protect the worker against silicosis. The discussion is illustrated with diagrams, and it is shown by examples that it is possible to solve the problem of dust abatement in stoneworking. Author

N67-35111# Israel Program for Scientific Translations, Ltd., Jerusalem.
TESTING THE TIGHTNESS OF FILTER SEATS
V. Koelm *In its* Hyg. Effects and Control of Dusts, Fogs, Gases, Vapors, Radioact. Particles 1966 p 50–53 (See N67-35101 20-15)

The method and equipment for leakage testing in filter seats used for radioactive aerosol filters are described. Data of leakage rate tests are tabulated, and reasons for leaks are outlined. N.E.N.

N67-35136# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.
ELECTRIC SMELTING OF COMPLEX LEAD–ZINC SINTER
Richard N. Spencer, Seth C. Schaefer, and James E. Mauser Aug. 1967 32 p refs
(BM-RI-6999)

Electric-furnace smelting for simultaneous recovery of zinc spelter and lead bullion from complex lead–zinc sinter was investigated. Reduction of lead and zinc was satisfactory. Condensation of lead and zinc vapor to pyrophoric metal powder in a water-cooled, shock-condensing system produced excellent recoveries. Metal-splash condensation to produce zinc spelter was unsatisfactory. Special smelting experiments differentiated the effects of several smelting parameters on zinc metal recovery. The principal cause for unsatisfactory zinc metal recovery was transfer of iron to the condenser and subsequent degradation of zinc in a mixture composed of lead and an iron–zinc intermetallic compound. Limitations of the process were determined. Slag-resistance open-bath electric smelting of complex lead–zinc sinter is not considered feasible. Author

N67-35144# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NOVELITIES IN FORGING AND STAMPING PRODUCTION
10 Mar. 1967 41 p refs Transl. into ENGLISH from the Russian
(FTD-HT-66-375; AD-653505)

CONTENTS:

1. DETERMINATION OF BASIC PARAMETERS OF MACHINES FOR HIGH-SPEED METAL FORMING Yu. P. Sogrishin, F. G. Suvorov, N. F. Kobyakovskiy, and A. V. Popov p 1–17 refs (See N67-35145 20-14)

2. STUDY OF PRESSWORKING OF STEELS IN THE SEMI-HOT STATE P. D. Chudakov, V. D. Il'ich, and A. A. Borovitchenko p 18–27 refs (See N67-35146 20-15)

3. RUBBER-PAD METHOD FOR HIGH-SPEED STAMPING OF SHEET METAL Yu. P. Sogrishin, F. G. Suvorov, and V. Ya. Moroz p 28–35 refs (See N67-35147 20-15)

N67-35145# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF BASIC PARAMETERS OF MACHINES FOR HIGH-SPEED METAL FORMING
Yu. P. Sogrishin, F. G. Suvorov, N. F. Kobyakovskiy, and A. V. Popov *In its* Novelties in Forging and Stamping Production 10 Mar. 1967 p 1–17 refs (See N67-35144 20-15)

Results of a study which was performed in order to select the type, design, and parameters of a machine intended for high-speed forming of metals are presented. The study was performed in two directions: study of the experimental installation and technological studies of open die upsetting, upsetting with efflux, and forward and backward extrusion. Author

N67-35146# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDY OF PRESSWORKING OF STEELS IN THE SEMI-HOT STATE
P. D. Chudakov, V. D. Il'ich, and A. A. Borovitchenko *In its* Novelties in Forging and Stamping Production 10 Mar. 1967 p 18–27 refs (See N67-35144 20-15)

Main advantages of pressworking of steels in semi-hot state and some features of cold and hot pressing are outlined. Results of the first stage of a study to determine basic parameters of this process are presented, and the problem of improving the quality of forgings thus obtained is discussed. Lubricants that were prepared and tested are listed. Author

N67-35147# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RUBBER-PAD METHOD FOR HIGH-SPEED STAMPING OF SHEET METAL
Yu. P. Sogrishin, F. G. Suvorov, and V. Ya. Moroz *In its* Novelties in Forging and Stamping Production 10 Mar. 1967 p 28–35 refs (See N67-35144 20-15)

A study performed to determine the production-process capabilities of high-speed stamping using the rubber-pad method is described. Advantages and shortcomings of this method are presented. Parting and forming operations are discussed in detail. Author

N67-35168# General Electric Co., Philadelphia, Pa. Re-Entry Systems Dept.
SYSTEMS ESTIMATION FROM VARIABLES PERFORMANCE PARAMETERS
S. Demskey 30 Nov. 1966 48 p refs
(Doc.-66SD342)

This report describes VAEP (for Variables/Attributes/Error Propagation) which should provide satisfactory system estimates from variables data until an exact multivariate tolerance formula is developed. Although reduced sample size is the benefit most easily recognized, there are others of importance and interest. Although the entire gamut of statistical method is used, the combining of statistical tolerance limits and error propagation is the unique ingredient in VAEP. Author

N67-35176# Tokyo Univ. (Japan). Inst. of Industrial Science.
IMPROVEMENT OF HANDLING CHARACTERISTICS OF THE VEHICLE AS A MAN–MACHINE SYSTEM
Osamu Hiraо, Eiichi Kikuchi, and Naoyuki Yamada May 1967 29 p refs *Its* Vol. 17, No. 7, Ser. 114
CFSTI: HC $3.00/MF $0.65

Dynamic lags of steering and the chassis system itself are considered in terms of improving man's ability to handle a land vehicle. Steering system of an experimental vehicle is shown, and the transfer function of the system as well as improving its dynamic characteristics are discussed. Results are included for direction change and lane change experiments, and the emphasis is on the role of the human driver in a man–machine system. M.W.R.

N67-35263# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Munich (West Germany). Inst. fuer Physik der Atmosphaere.
INVESTIGATION OF THE COLLECTION EFFICIENCY OF FIBER FILTER ESPECIALLY CONCERNING RADIOACTIVE AEROSOLS [UNTERSUCHUNG DES ABSCHEIDEVERHALTENS VON FASERFILTERN UNTER BESONDERER BERUECKSICHTIGUNG RADIOAKTIVER AEROSOLE]
H. Schuster May 1967 111 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-35) CFSTI: HC $3.00/MF $0.65

Collection efficiency of a fiber filter during filtration of radioactive aerosols is analyzed theoretically and experimentally as a function of gas pressure, travelling speed, particle diameter, and aerosol density. Measurements were performed using plastic-fiber filters, monodisperse polystyrene latex, and paraffin aerosols in the range of 0.1 μ–1.3 μ particle diameter; and the aerosols were characterized by loading with radioactive material. The experiments were performed at constant temperature and constant relative humidity in the gas flow. Pressure and travelling speed varied in the range of 2 to 760 mm Hg and 20 to 450 cms^{-1}. Effects resulting from electrostatic charge were excluded. The relations obtained allow the estimation of collection efficiency during measurements in the free atmosphere under extreme conditions. Author

N67-35273# Hauptverband der Gewerblichen Berufsgenossenschaften, E. V., Bonn (West Germany).
STUDIES OF FILTER MATERIALS WITH REGARD TO THEIR SUITABILITY FOR THE MEASUREMENT OF RADIOACTIVE AEROSOLS [UNTERSUCHUNGEN AN FILTERMATERIALIEN AUF IHRE EIGNUNG ALS MESSFILTER ZUR BESTIMMUNG RADIOAKTIVER SCHWEBSTOFFE IN LUFT]
D. Hasenclever Brussels, EURATOM, May 1967 38 p refs In GERMAN; ENGLISH summary
(Contract EURATOM-004-62-12 PSTD)
(EUR-3178.d) CFSTI: HC $3.00/MF $0.65

The studies carried out show that there are two main groups of filters, namely: (1) Those having an efficiency which may vary greatly depending on the inlet flow-rate for the 0.01–1 μm particle size range considered here. Average efficiencies of above 85% are not attained in this group at the inlet flow-rates used at the stations and for aerosols of less than 0.3 μm diameter (31.5–82.6%). In the case of oil mist (0.2–1 μm diameter), however, efficiencies of 7.0 to 99.98% can be attained, depending upon the flow-rate. Using the same filter material there may be wide efficiency fluctuations from filter to filter, which create the illusion of fluctuations in the radioactive aerosol concentration. Efficiency may vary greatly with particle size. The minimum efficiencies depend upon particle size and air-velocities. (2) Filters whose efficiency for the relevant particle size range varies with the flow-velocity chosen but is always over 97%. With oil mist (0.2–1 μm diameter) their efficiency is always more than 99.7%. Even these high-efficiency filters have fairly clearly defined minima, which vary as a function of the aerosol particle size and the air-velocity. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N67-34297# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
MEASUREMENT OF ATMOSPHERIC AEROSOLS BY POLARIZED-LASER LIGHT SCATTERING
Roger W. Call, E. Paul Palmer, and Richard W. Grow Jun. 1967 134 p refs
(Grant NSF GP-874)
(UTEC-MD-67-034; NSF-11)

A new method using measurements of light scattered from a polarized laser beam to find the aerosol attenuation coefficient, the aerosol number density and the aerosol size distribution is presented. The method was tested by making measurements from a secondary site distant from the laser transmitter. Results are plotted for attenuation coefficients up to 30 kilometers in altitude. The Rayleigh theory of light scattering by small particles is reviewed for the case of a polarized incident light beam. The Mie theory of light scattering is applied to aerosol scattering, and Mie scattering functions are computed for various aerosol size distributions. Theory is developed for making two-station backscatter measurements using a pulsed ruby laser as a light source. The final solution to the equation for aerosol attenuation coefficients depends only on the angular functions for Rayleigh and Mie scattering and upon the relative voltage responses at the distant receiver for the two separate measurements taken at each altitude. Author

N67-34421# Raytheon Co., Waltham, Mass. Research Div.
RESEARCH STUDY OF A CO_2 LASER RADAR TRANSMITTER Semiannual Technical Summary Report, 1 Nov. 1966–1 May 1967
Perry A. Miles and Frank A. Horrigan Jun. 1967 55 p refs
(Contract N00014-67-C-0264; ARPA Order 306)
(S-970; AD-653725) CFSTI: HC$3.00/MF$0.65

The report concerns the investigation of physical properties of laser amplifiers, using electrically excited mixtures of CO_2, N_2, and He with a view to producing high-power pulse emission with well-controlled temporal and spatial form. The object of this investigation is to design and build such a source with an average power of 1 kw in a form suitable for use as a laser radar transmitter. Designs have been developed for both dc- and pulse-excited amplifiers and the physical quantities of importance in these designs have been measured. The most notable of these are: the signal intensity required to drive an amplifier to saturation, information on the refractive properties of the discharge, the time constant determining maximum pulse repetition rates, both for the input pulse trace and for the pulse excitation process, and the practical gain levels that can lead to self-oscillation in the amplifier. These measurements lead to the choice of a system in which a train of 10–15 μsec pulses at a repetition rate of 10–12 kc is amplified by a 50-meter length of dc-excited power amplifier. Author (TAB)

N67-34688# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
AVAILABLE LASER WAVELENGTHS FOR VISIBLE AND NEAR-INFRARED SPECTROSCOPY
C. F. Dewey, Jr. Mar. 1967 16 p refs
(IPP-2/60) CFSTI: HC$3.00/MF$0.65

Recent advances in semiconductor injection lasers and frequency-changing methods have significantly broadened the wavelengths spectrum in which laser energy can be generated. A review of available techniques in the visible and near-infrared is presented. At the present time, it appears possible to produce measurably intense coherent radiation at all wavelengths from 3245 A to over 5μ. Author

N67-34952# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
THE EFFECTS OF BUFFER GAS PRESSURE AND CONCENTRATION ON HOLE BROADENING IN GAS LASER SYSTEMS
Maylin H. Dittmore and Richard W. Grow Jan. 1967 166 p refs
(Grant NSF GK-29)
(NSF-10)

The effects of thermal elastic collisions on upper state excited atoms in a laser system are considered. A model, wherein the atoms are considered to be smooth, frictionless spheres, is employed in a classical treatment of the thermal collisions. The probability of an excited atom being transferred from one position on the inhomogeneously broadened distribution to another is calculated. A periodic approximation of the error integral is used to simplify the expression for the transfer probability. Computer solutions for the two cases of Ne–He collisions and Ne–Ne collisions are carried out. From the transfer probability functions, the broadening of the natural line width due to hard collisions and the broadening of the holes in the excited atomic distribution due to soft collisions are calculated. It is shown that broadening due to soft collisions is much greater than that due to hard collisions in the 6328Å Ne–He laser system. Measurements of hole widths using the concentration ratio and total pressure as parameters are made on the 6328A Ne–He laser system. Measurements are found to agree well with the calculations. Author

N67-35020*# Hughes Research Labs., Malibu, Calif.
INVESTIGATION OF POTENTIALITIES OF PHOTOCHEMICAL LASER SYSTEMS. PART 2-PRELIMINARY EXPERIMENTAL STUDIES Final Report, 1 Feb. 1966–31 Jan. 1967
Feb. 1966–31 Jan. 1967
C. R. Giuliano, L. D. Hess, and J. D. Margerum 31 Jan. 1967 47 p
(Contract NAS12-94)
(NASA-CR-85006) CFSTI: HC$3.00/MF$0.65 CSCL 20E

Photodissociative laser systems are proposed and evaluated with regard to their potential for conversion of solar radiation to monochromatic coherent emission. Spectroscopic and photochemical properties of several molecules which absorb light in the visible and near ultraviolet regions are reported, discussed, and compared with requirements for obtaining laser action. Additional mechanisms for achieving population inversions in these systems indirectly, such as Franck–Condon pumping and association processes stabilized by stimulated emission, are also discussed. Preliminary experimental studies are reported for methyl iodide and bromide, iodo- and bromocyanogen, iodine bromide, and nitrogen dioxide. Laser action was observed under a variety of experimental conditions from CF_3I and NOCl, but could not be detected in the initial studies conducted with other compounds. Chemical reversibility was demonstrated for the nitrosyl chloride system using mixtures of molecular chlorine and nitrosyl chloride. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N67-34024# General Electric Co., Schenectady, N. Y. Research and Development Center.
SOME PHYSICAL AND CHEMICAL PROPERTIES OF GRAIN BOUNDARIES
K. T. Aust Sept. 1966 22 p refs Presented at the Army Mater. Res. Conf. on Phys. and Chem. Characteristics of Surfaces and Interfaces, Raquette Lake, N. Y., 23–26 Aug. 1966
(Rept.-66-C-326)

Experimental data on the energy, migration, and corrosion behavior of grain boundaries in metals are presented. The interfacial energy data provide support for the coincidence lattice model of the structure of high-angle boundaries. The results of the boundary migration studies are in agreement with the theory of impurity-controlled motion proposed by Cahn. The work on grain-boundary corrosion demonstrates a useful approach to intergranular corrosion problems of commercial alloys. Author

N67-34026# General Electric Co., Schenectady, N. Y. Research and Development Center.
GROWTH AND PREFERRED ORIENTATIONS OF LARGE ELONGATED GRAINS IN DOPED TUNGSTEN SHEET
J. L. Walter Oct. 1966 31 p refs
(Rept.-66-C-346)

Tungsten ingots with and without small amounts of Al, Si, and K were prepared by powder metallurgy techniques and rolled to 0.001-inch-thick sheet. The ingots were rolled three ways: (1) cross-rolled, then straight-rolled; (2) straight-rolled; and (3) straight-rolled, then cross-rolled. Reductions were 99.8%. Samples were annealed, *in vacuo*, at temperatures from 1200° to 2200°C. Substructures and textures were determined by electron microscopy and X-ray defraction. The doping agents formed particles of mullite ($Al_6Si_2O_{13}$), which, on rolling, formed strings parallel to the rolling direction. These strings of particles increase the recrystallization temperature by 800°C and limit lateral grain growth while allowing growth parallel to the rolling direction. This results in the formation of large elongated grains of preferred orientation. Undoped sheet recrystallized to small equiaxed grains. The preferred orientations of the large grains were determined to be (113) ⟨691⟩, (013) ⟨362⟩, and (118) ⟨304⟩ types. Author

N67-34034# Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe.
ANISOTROPY OF LONG RANGE ORDER IN ALLOYS
Peter Sigmund Dec. 1966 25 p refs
(JUL-421-RW) CFSTI: HC $3.00/MF $0.65

A simple derivation is given of a set of order parameters describing the state of long range order of alloys with more than two types of lattice sites and/or atomic species. These parameters are used to calculate the decrease in long range order due to irradiation with fast electrons or heavy ions at low temperatures. It is shown that irradiation of a single crystal and subsequent X-ray analysis may provide 1) a demonstration of the possibility of anisotropic disordering, 2) experimental evidence of the existance of replacement sequences, and 3) some information about the range distribution of replacement sequences. Author

N67-34047# United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.
COMBINATION OF HIGH-TEMPERATURE PLASTIC DEFORMATION AND QUENCH HARDENING
M. G. Lozinskii, V. D. Sadovskii, and E. N. Sokolkov Sep. 1966 14 p refs Transl. into ENGLISH from Novye Protsessy Obrabotki Metal. Davleniem, Akad. Nauk SSSR, Inst. Mashinoved. (Moscow), 1962 p 85–93
(AERE-Trans-1071) CFSTI: HC $3.00/MF $0.65

Particular features of a process of combining high temperature plastic deformation of steel with quench hardening to form a strong material, are examined. The steps of the procedure: austenitization, undercooling of the austenite (400°–600°), deformation with 90% reduction, quench hardening to martensite, and low temperature tempering (100°–200°), are discussed. The procedure is compared to other thermomechanical treatments for strengthening structural alloy steels. L.S.

N67-34054# Westinghouse Electric Corp., Pittsburgh, Pa.
CHEMICAL PHYSICS OF SURFACE REACTIONS OF METALS Final Report, 1 Jun. 1965–31 May 1967
Earl A. Gulbransen and Richard L. Tallman Washington, ONR, 31 May 1967 127 p refs
(Contract Nonr-4949(00))
(Rept.-67-9B6-SURFC-R1; AD-653723) CFSTI: HC $3.00/MF $0.65

A survey is made of studies at the Westinghouse Research Laboratories on the structure of oxide films and the formation of localized oxide growths on iron. Filamentary whisker growths are formed when iron is oxidized in dry oxygen at 400 to 500C. Long, blade-like platelets are formed at 450C in atmospheres containing both water vapor and a trace of oxygen. The oxide whiskers and the blade-like platelets produce fiber-texture patterns showing exclusively alpha-Fe2O3 diffraction. Selected-area electron diffraction patterns of individual growths indicate (1) that the most simple whiskers have a single axial screw dislocation and (2) that the blades are twinned on the blade-face plane. Growth mechanisms based on easy paths for diffusion along the axial dislocation in the oxide whisker and along the twin plane in the oxide blade-like platelet are proposed. Some calculations relevant to the internal diffusion mechanism in whiskers are presented. Author (TAB)

N67-34074# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PHYSICAL CHARACTERIZATION OF MOLYBDENUM SINGLE CRYSTALS FOR IRRADIATION EXPERIMENTS
H. E. Kissinger, J. L. Brimhall, and B. Mastel Nov. 1966 21 p refs Presented at the Intern. Conf. on the Characterization of Mater., University Park, Pa., 16–18 Nov. 1966
(Contract AT(45-1)-1830)
(BNWL-SA-777; CONF-661126-1) CFSTI: HC $3.00/MF $0.65

Radiation effects on near-perfect high-purity Mo single crystals were investigated. It was found that neutron irradiation of such crystals creates point defects, vacancies and interstitials. The interstitials interact to form two-dimensional clusters which serve as sinks for additional interstitials. Vacancies persist as isolated defects on very small clusters coherent with the original clusters. Black spots observed by electron microscopy are interpreted as interstitial clusters which grow with increasing exposure. N5A

N67-34138# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung.
THE FORMATION OF NEW METAL PHASES ON THE SURFACES OF METALS IN CONTACT WITH LIQUID SODIUM AT 600°C [DIE BILDUNG NEUER METALLISCHER PHASEN AN DER OBERFLAECHE VON MIT FLUESSIGEM NATRIUM VON 600°C IN KONTAKT STEPHENDEN METALLEN]
Hans Ulrich Borgstedt Oct. 1965 8 p refs In GERMAN
(KFK-408)

The mass transport occurring when a plate of Incoloy 800 in a capsule of V4A-steel was placed in contact with liquid Na at 600°C was studied. After 1000 hours of contact the corrosion rate was measured by microgravimetric methods as 4.0 ± 0.1 mg/dm^2 month. Small crystals three to five μ in diameter and obviously cubic were growing on the Incoloy 800 sheet. The microcrystals were at the grain boundaries of the Incoloy 800. The chemical composition and the structure of the crystals was not determined. NSA

N67-34140# Compagnie des Ateliers et Forges de la Loire, Paris (France). Departement des Recherches.
[MECHANICAL CHARACTERISTICS OF AUSTENITIC STEELS] Quarterly Report, Apr.-Jun. 1966
Jun. 1966 76 p refs
(Contract EURATOM-033-64-9-TEEF (RD))
(QR-7; EURAEC-1783; EUR-3325) CFSTI: HC $3.00/MF $0.65

Creep characteristics of austenitic stainless steels at 600°C are reported as are results of stress corrosion tests on austenitic and austeno-ferritic stainless steel wires conducted in boiling $MgCl_2$ solutions at temperatures between 100 and 200°C. Techniques and equipment used to conduct the tests are described. NSA

N67-34170# Battelle-Northwest, Richland, Wash.
PRACTICAL TECHNIQUE FOR OBTAINING AND USING PLASTIC ANISOTROPY INFORMATION
D. R. Ireland Feb. 1967 54 p refs Presented at IMD Titanium Symp. of the 96th AIME Ann. Meeting, Los Angeles, 19-23 Feb. 1967
(Contract AT(45-1)-1830)
(BNWL-SA-902; CONF-670208-4) CFSTI: HC $3.00/MF $0.65

The Knoop microhardness test can be applied to studies of texture strengthening in Ti alloys. A Knoop Hardness Number (KHN) is empirically assumed to represent a stress deviation. It is also assumed that the direction of the stress deviator is determined by the orientation of the impression relative to the principal axes of anisotropy. This assumption is the basis for using KHN values to construct a closed curve representing the shape of a flow surface. Previous studies have demonstrated the utility of the microhardness flow surface technique for investigations of Zr alloys. An investigation of applying the technique to Ti alloy studies is described. Author (NSA)

N67-34232# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACADEMY OF SCIENCES OF THE USSR INSTITUTE OF METALLURGY
20 Mar. 1967 42 p refs Transl. into ENGLISH from Tr. Inst. Met. Akad. Nauk SSSR (Moscow), 1962 p 11-23, 147-152
(FTD-MT-65-421; AD-652470)

CONTENTS:

1. STRUCTURAL-ENERGY THEORY OF FATIGUE OF METALS V. S. Ivanova p 1-22 refs (See N67-34233 20-17)

2. INVESTIGATION OF THE PROCESS OF FATIGUE DESTRUCTION OF METALS BY THE METHOD OF MAGNETIC HYSTERESIS AND EDDY CURRENT LOSSES O. I. Gushcha p 23-33 refs (See N67-34234 20-17)

N67-34233# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRUCTURAL-ENERGY THEORY OF FATIGUE OF METALS
V. S. Ivanova *In its* Acad. of Sci. of the USSR Inst. of Met. 20 Mar. 1967 p 1-22 refs (See N67-34233 20-17)

The existing theories of fatigue (work hardening, hardening and softening, dislocatory and energy) are deficient because they were developed through work only on structural factors or only on energy presentations about the development of the porcess of fatigue. The proposed theory considers both the structural changes occurring in the metal and the energies required for processes in different periods of fatigue. This theory is based on the energy of destruction being independent of how the energy is supplied. The processes of destruction, plastic deformation and fusion are compared, and the obtained dependences are analyzed. Using the new regularities of fatigue herein established allows a substantial reduction in fatigue-test time and in calculating the curve of the start of damage susceptibility in metals. Author

N67-34234# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE PROCESS OF FATIGUE DESTRUCTION OF METALS BY THE METHOD OF MAGNETIC HYSTERESIS AND EDDY CURRENT LOSSES
O. I. Gushcha *In its* Acad. of Sci. of the USSR Inst. of Met. 20 Mar. 1967 p 23-33 refs (See N67-34232 20-17)

This work investigates the effect of fatigue of high-carbon steels, U12A, U10, U9A, alloy-steel 40Kh and heat-resisting alloy EI435 on their electromagnetic (total energy losses on magnetic hysteresis and eddy currents) and mechanical (microhardness and cyclic strength) characteristics and microstructure, and the interconnection of these characteristics in the process of fatigue. The samples were tested during bending with rotation. The process of fatigue is divided into four periods and they are described. The electromagnetic and mechanical characteristics changed continuously, and the changes under the effect of sign-alternating stresses indicate a close connection between these characteristics. These changes depict the development of distortions of the crystal lattice, which lead to work hardening and then to the softening of the metal. Laboratory and industrial tests showed the high-effectiveness of the method for determining the place and degree of fatigue. Author

N67-34264# Reactive Metals, Inc., Niles, Ohio. Research and Development Dept.
THE INFLUENCE OF COMPOSITION AND HEAT TREATMENT ON THE AQUEOUS-STRESS CORROSION OF TITANIUM
S. R. Seagle, R. R. Seeley, and G. S. Hall 15 Mar. 1967 38 p refs
(Rept.-492)

Chemical composition and heat treatment were found to effect the aqueous-stress corrosion of titanium. Aluminum contents greater than 5 percent and oxygen contents greater than about 0.3 percent caused appreciable sensitivity to stress corrosion. The additions of beta-isomorphous type alloying elements, such as molybdenum, were beneficial for Ti-Al alloys but showed no improvement for Ti-O alloys. The amount of oxygen that could be tolerated was reduced substantially by the addition of aluminum. The heat-treatment temperature for maximum sensitivity to stress corrosion increased from 1000°F for Ti-8%Al alloys to 1200°F for Ti-8%Al alloys. This corresponds to about 150°F below the estimated Ti_3Al transus. The stress-corrosion resistance of Ti-6Al-4V alloy was reduced by long annealing times prior to exposure in the Ti_3Al region. Long annealing times also promoted stress corrosion in Ti-O alloys. Microscopic examination did not reveal significant changes with annealing time, which indicates the metallurgical factors affecting the stress-corrosion resistance are related to submicroscopic changes. Author

N67-34318# United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.
BASIC TYPES OF DEFORMATION MICRO-CONTOUR APPEARING AT ELEVATED TEMPERATURES IN POLYCRYSTALLINE METALS HAVING A FACE-CENTERED CUBIC LATTICE
M. G. Lozinskii and N. Z. Pertsovskii Oct. 1966 33 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSR, Otd. Tekhn. Nauk Met. i Toplivo (Moscow), v. 1, 1962 p 105–126
(AERE-TRANS-1069) CFSTI: HC $3.00/MF $0.65

A method of classifying the microcontours is discussed and photomicrographs illustrating the different types are presented. All types of deformation microcontours were divided into two groups: those which appear within the grains of metals and alloys subjected to deformation over a wide temperature range, and those which appear principally on the grain boundaries during testing. The experimental data were obtained by studying the microstructure of test pieces made from metals of the platinum group, commercial-purity nickel, and also a number of single-phase alloys of nickel with iron and molybdenum. Use was made of high temperature metallographic methods permitting a study of the microstructure on the polished surface of a test piece by direct observation in a microscope during tensil testing under heating in vacuo. Author

N67-34319# Atomic Weapons Research Establishment, Aldermaston (England).
HYDROGEN IN BERYLLIUM
P. M. S. Jones and R. Gibson Feb. 1967 29 p refs
(AWRE-O-2/67)

The diffusion coefficient and solubility for hydrogen in beryllium were determined. Tritium and a cast beryllium disk 0.031 in. thick were used. The disk was outgassed, placed in a vacuum apparatus, soaked in tritium, and the tritium was removed. Enough hydrogen to maintain a pressure of 30 cm Hg was circulated around the disk and recompressed into the ion chamber to determine its tritium content. Smooth plots of cummulative tritium released against time were obtained. The diffusion coefficient is determined to be 3.0×10^{-7} exp(4430/RT) and the diffusion activation energy is 4.4 ± 0.5 kcal/mole. The solubility is given as 7.9×10^{-3} $e^{+(0.44\pm0.97)/RT}$ Curves of the cumulative tritium showed a stepwise shape when the temperature was raised during the final outgassing, and this is attributed to hydrogen trapping at a series of sites of different energy. N.E.N.

N67-34336 Canada. Dept. of Mines and Tech. Surveys, Ottawa.
WELDABILITY OF TITANIUM AND TITANIUM ALLOYS
K. Winterton Apr. 1965 25 p refs
(TB-71) Available from the Queen's Printer, Ottawa: $0.50

Titanium is very reactive and is easily contaminated by carbon, hydrogen, oxygen or nitrogen. During welding, the hot metal must be protected at all times from the atmosphere, and it may be necessary to pay special attention to the purity of inert gases used for shielding. Commercially pure titanium and the alpha alloys are the most readily weldable, and have been considered as a group. The alpha-beta and beta alloys can be joined, but the welds tend to be brittle, and vary in their response to heat-treatment. These alloys often need individual techniques and treatment to obtain optimum properties in the welded joints. The most useful fabrication methods are tungsten inert-gas welding, metal inert-gas welding, and resistance spot and seam welding, and these have all been used extensively in aerospace applications. Good brazing methods have been developed and may be useful for "honeycomb" structures. Other specialized methods, such as electron-beam welding and explosive welding, have been tried successfully. In the U.S.S.R., submerged-arc welding and electro-slag welding are the most popular methods. Author

N67-34376*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DIFFUSION OF CARBON FROM CARBIDE OF URANIUM INTO MOLYBDENUM AND TUNGSTEN
V. S. Eremeyelev, A. S. Panov, B. F. Ushakov, and Ye. V. Fiveiskii *In its* Contact Diffusion Interaction of Mater. with Cladding 19 May 1967 p 11–24 refs (See N67-34374 20-23)

In a study of contact diffusion interaction of materials with cladding, the interaction of the condensate film with the material during isothermal heating is presented. This heating may occur at the expense of a decrease of the content of one of the components of the cladding material and not as a result of the interchange reaction. It is borne out that geometric correlations have a substantial influence on the character of diffusion process in such a system. This is shown by the example of contact diffusion of monocarbide of uranium with molybdenum and tungsten. R.U.

N67-34377*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RESEARCH INTO THE DIFFUSION OF CARBON INTO ZIRCONIUM AND ZIRCONIUM CARBIDE
R. A. Andrievskii, V. N. Zagryazkin, and G. Ya. Meshcheryakov *In its* Contact Diffusion Interaction of Mater. with Cladding 19 May 1967 p 25–35 refs (See N67-34374 20-23)

To expand knowledge on contact diffusion interaction of materials with cladding, various diffusion interactions between materials and their claddings and the film of condensate formed on their surfaces are discussed briefly. Emphasis is on a study of data concerning the diffusion of carbon in zirconium carbide. R.U.

N67-34393# Mound Lab., Miamisburg, Ohio.
REACTOR FUELS AND MATERIALS DEVELOPMENT PLUTONIUM RESEARCH Annual Report, 1965
L. J. Wittenberg and G. R. Grove 20 Jan. 1967 46 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1328) CFSTI: HC $3.00/MF $0.65

Developments are reported for studies on phase studies on Pu–Ce–Ni, Pu–Ce–Fe, Pu–Au, and Pu–rare earth alloys; crystal structure of $PuCu_6$; allotropic transformations of Pu; thermal analysis tschniques; calorimetry of δ, δ', and ϵ Pu; densities of liquid Nd and Pu–Ce alloys; viscosities and liquidus temperature of Pu–Ce alloys; viscosities of liquid Pb, Sn, U, and Yb; and UO_2 microspheres. NSA

N67-34394*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SLIDING FRICTION OF SOME MEMBERS OF THE PLATINUM METALS GROUP
Donald H. Buckley Washington, NASA, Sep. 1967 17 p refs
(NASA-TN-D-4152) CSCL 11F

The metals examined were ruthenium, rhodium, osmium, and iridium. Rhodium, ruthenium, and iridium were observed in sliding contact with themselves, while osmium was in sliding contact with iridium. The hexagonal metal ruthenium and the face-centered cubic metal rhodium were also made to slide in contact with polycrystalline aluminum oxide. The friction experiments were conducted at ambient pressures from 760 to 10^{-11} torr with a hemispherically tipped rider sliding on a rotating flat disk. Experiments were conducted at sliding velocities of 0.001 and 200 centimeters per second, at ambient temperatures from 20° to 500°C, and at loads from 50 to 100 grams. The results of this investigation show that the face-centered cubic platinum metals rhodium and iridium exhibit markedly higher friction coefficients at low ambient pressures than the close-packed hexagonal metals osmium and ruthenium. Stick-slip motion was observed with the face-centered cubic metal rhodium, but not with the hexagonal

metal ruthenium under identical conditions. Surface contaminants had the greatest effect on the face-centered cubic metal rhodium. Friction data for the hexagonal metals osmium and ruthenium correlate with the fundamental relation between the friction coefficients of hexagonal metals and their c/a lattice ratios established in an earlier study. Author

N67-34413 Royal Aircraft Establishment, Farnborough (England).
MULTIPLE IMPACT RAIN EROSION STUDIES AT VELOCITIES UP TO 450 M/S (M 1.3)
R. B. King Jan. 1967 36 p refs
(RAE-TR-67019)

Studies have been made of the rain erosion resistance of a variety of materials at impact speeds up to 450 m/s (1006 mile/hr). The experimental work was carried out on the whirling arm facility at Dornier System, Immenstaad, W. Germany. At 450 m/s all the materials examined were seriously damaged in times ranging from 15 s for Perspex to 1 hr for stainless steel under equivalent rainfall conditions. It was shown that the results obtained on the Dornier rig fitted in well with the results previously obtained at subsonic velocities at the R.A.E. Author

N67-34458# Aeronautical Research Labs., Melbourne (Australia).
X-RAY INVESTIGATION OF AGEING IN AN ALUMINUM 5% MAGNESIUM ALLOY WITH SMALL SILVER ADDITIONS
J. H. Auld Dec. 1966 16 p refs
(ARL/MET-62) CFSTI: HC $3.00/MF $0.65

The structural changes associated with aging of aluminum-5 wt.% magnesium alloys containing 0.5 and 1.0 wt.% silver were investigated by X-ray diffraction methods. At lower temperatures and shorter times, the hardening is shown to be due to the formation of approximately spherical Mg–Ag zones having an AuCu I type structure. Initially the zones are coherent with the matrix but with further aging their tetragonality increases, mainly due to a decrease in the c axis, and to accommodate the increasing stress, orientation changes occur such that $(101)_{zone} \parallel (110)_{Al}$ and $[010]_{zone} \parallel [001]_{Al}$. The lattice parameters of the zones at this stage are a = 4.42 Å, c = 3.48 Å c/a = 0.79. Line breadth measurements indicate that they have an average size of at least 60 Å. Author

N67-34533*# Stanford Univ., Calif. Dept. of Materials Science.
MECHANISMS OF STRENGTHENING AND FRACTURE IN COMPOSITE MATERIALS Progress Report, 1 Dec. 1966–1 Jun. 1967
A. S. Tetelman Jun. 1967 8 p
(Grant NsG-622)
(NASA-CR-87797; PR-6) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The effect of drilled holes on the notch toughness of iron base alloys is considered, as are fracture mechanisms in quenched and tempered steels. Other studies on strengthening mechanisms in composite materials deal with strength and fracture of a unidirectionally solidified Al–Ne eutectic alloy, a theoretical investigation of dislocation distributions in two-phase systems, and elastic–plastic cracks in two-phase materials using either a shear crack dislocation model or a classical continuum elasticity approach. M.W.R.

N67-34838* International Lead Zinc Research Organization, New York.
INTERNATIONAL LEAD ZINC RESEARCH ORGANIZATION, RESEARCH DIGEST NO. 19, OCTOBER, 1966 TO APRIL, 1967. PART II—ZINC FOR CORROSION PROTECTION
Apr. 1967 31 p refs

Research and development of galvanizing processes and zinc rich paints are summarized. Problems connected with the hot dip galvanizing of high strength, low alloy steels, containing a high silicon content, are investigated. The constitution of the FeSi compound of the iron–silicon–zinc system was worked out. Vanadium and nickel additives to the galvanizing bath were found to be beneficial in pilot-scale tests. Clear protective coatings and porcelain enamels were investigated, along with the adhesive properties of paints and the effects of surface conditions. Research on potential and actual applications of zinc are reported, and include welding zinc-coated structurals, the mechanical behavior of galvanized bolts and structural joints galvanized coatings for elevated temperatures, galvanized steel reinforcement in concrete, and coating systems for sprayed zinc. Test results on organic and inorganic based paints and primers using zinc dust and on the dust size effects are summarized. N.E.N.

N67-34563# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINING THE MECHANICAL PROPERTIES OF METAL OF WELDED LOW ALLOYED SEAMS BY THEIR CHEMICAL COMPOSITION
B. D. Lebedev *In its* Chem. and Chem. Technol. Pt. II: Trans. 23 Dec. 1966 p 10–20 refs (See N67-34561 20-15)

It is established that the mechanical properties of welded seam metal in a thermally non-developed state are subject to the additiveness law with the investigated concentrations of the alloying elements. Formulas are given for an approximate calculation of mechanical properties of seam metal by their chemical composition. It was established that molybdenum, at a content of up to 1%, raises the strength characteristics of seam metal. The positive effect of aluminum on plastic properties of seam metal was also determined. Author

N67-34642 Aeronautical Research Labs., Melbourne (Australia).
CRACK INITIATION IN COPPER AND BRASS SUBJECTED TO LARGE-AMPLITUDE ALTERNATING TORSION
S. Mck. Cousland May 1966 11 p refs
(ARL/MET-40)

Cracking in copper and brass subjected to large-amplitude alternating torsion is initiated by the nucleation and growth of small voids which link up to form micro-cracks. The voids form in irregular misorientation zones produced during straining, so that the micro-cracks themselves are irregular in appearance. It is suggested that void nucleation is closely connected with stress-relaxation at the misorientation zones. Author

N67-34643 Aeronautical Research Labs., Melbourne (Australia).
X-RAY POWDER DATA OF T PHASES COMPOSED OF ALUMINUM AND MAGNESIUM WITH SILVER, COPPER AND ZINC
J. H. Auld and B. E. Williams Mar. 1966 9 p refs
(ARL/MET-36)

X-ray powder data of body centered cubic T phases of the $Mg_{32}(Al, Zn)_{49}$ type are presented in which the zinc is replaced by silver and copper. $Mg_{32}(Al, Ag)_{49}$ with Al:Ag = 6:1 and $Mg_{32}(Al, Cu)_{49}$ with Al:Cu = 6:1 are shown to be more correct formulas than Mg_4AgAl_8 and Mg_4CuAl_8, which have previously been suggested. The lattice parameters are 14.52±.01 Å and 14.35±.01 Å respectively. Author

N67-34649 Aeronautical Research Labs., Melbourne (Australia).
THE EFFECT OF FREE DISLOCATIONS OF YIELDING AND FRACTURE IN BODY-CENTERED CUBIC METALS
F. P. Bullen and H. L. Wain Jun. 1966 17 p refs
(ARL/MET-59)

The application of hydrostatic pressure to body-centered cubic metals can cause prismatic dislocations to form at elastic inhomogeneities, such as inclusions, and can strongly influence deformation and fracture behavior. For example, under conditions where yielding in iron occurs by dislocation glide, such free dislocations reduce the yield stress and can eliminate the sharp yield point; rounded yield points due to dislocation mobility effects can also be obtained. In recrystallized iron at low temperatures, where yielding normally occurs by twinning, the free dislocations increase the yield stress because initiation of twins at inclusions is suppressed. Author

N67-34658*# Douglas Aircraft Co., Inc., Newport Beach, Calif. Astropower Lab.
STRESS CORROSION CRACKING OF TITANIUM ALLOYS AT AMBIENT TEMPERATURE IN AQUEOUS SOLUTIONS Quarterly Progress Report, 1 Jan.–31 Mar. 1967
T. L. Mackay and C. B. Gilpin Mar. 1967 37 p refs
(Contract NAS7-488)
(NASA-CR-87432; SM-49105-Q3) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Electron microautoradiograph studies of distribution of hydrogen by gas adsorption in titanium alloys showed: (1) a uniform distribution in Ti-13V-11Cr-3Al alloy, (2) a concentration of hydrogen in beta phase of Ti-8Al-1Mo-1V and Ti-6Al-4V alloys, and (3) a segregation of hydrogen at beta precipitates in alpha grain boundaries in Ti-5Al-2.5Sn. Stress corrosion tests in distilled water and in 3% NaCl aqueous solution at ambient temperature were made employing single edge notch specimens of Ti-5Al-2.5Sn, Ti-6Al-4V, Ti-8Al-1Mo-1V, and Ti-13V-11Cr-3Al. The beta alloy, Ti-13V-11Cr-3Al, was the only material which showed good resistance to stress corrosion cracking in these environments. Electron microfractographs of stress corrosion fractures of alpha and alpha–beta alloys showed a mixture of cleavage and ductile dimple rupture. Cleavage areas were larger in salt solution tests. Profiles of the stress corrosion fractures of Ti-5Al-2.5Sn and Ti-6Al-4V show beta phase does not exhibit ductility, and cleavage occurs at the alpha–beta phase boundaries in the stress corrosion fracture. The preferential segregation of hydrogen in the beta phase appears to be associated with this local cleavage. Author

N67-34662 Aeronautical Research Council (Gt. Brit.)
CRACK PROPAGATION TESTS ON 2024-T3 UNSTIFFENED ALUMINUM ALLOY PANELS OF VARIOUS LENGTH-WIDTH RATIOS
T. J. Carger 1967 33 p refs Supersedes RAE-TR-66366; ARC-28946; See X67-18552
(ARC-CP-952; RAE-TR-66366; ARC-28946) HMSO: 6s 6d

Panels of 2024-T3 clad material of one width and of four length-width ratios were tested under constant amplitude fatigue loads in tension. Variations were observed in the rate of crack growth with change of length-width ratio. The variations are greatest at the highest stress level tested. The results for panels of small length-width ratio were influenced by the proximity of the end attachments to the test section. Information obtained from static longitudinal strain measurements was generally in accord with the results of the crack growth tests. It is recommended that tests performed to assess fatigue crack growth characteristics of materials in unstiffened panels, should be made with a length-width ratio about 2:1. Author

N67-34669*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
INVESTIGATION OF THE REINFORCEMENT OF DUCTILE METALS WITH STRONG, HIGH MODULUS DISCONTINUOUS, BRITTLE FIBERS Quarterly Report, 1 May–31 Jul. 1967
A. Gatti, J. M. Berry, J. J. Gebhardt, and J. Mullin Aug. 1967 37 p refs
(Contract NASw-1543)
(NASA-CR-87808; Rept.-2410-2E2; QR-3) CSCL 11D

An investigation was made of the critical factors affecting the reinforcement of ductile metals with short, brittle fibers. The materials systems used in the study were aluminum (or its alloys) and "ductile" epoxies reinforced with B_4C whiskers or with high modulus filaments, such as B_4C/B/W, SiC/W, B/W, etc. Related studies were made of economical processes for growing B_4C whiskers, deposition processes, the production of B_4C fibers, and the characterization of individual constituents in the final composites. C.T.C.

N67-34679# IIT Research Inst., Chicago, Ill.
RESEARCH ON ZIRCALOY BRAZE ALLOY DEVELOPMENT Quarterly Report, Jan. 1–Mar. 31, 1967
Deral E. Kizer and Z. P. Saperstein 17 Apr. 1967 15 p
(Contract AT(11-1)-578)
(IITRI-578-P29-11; EURAEC-1841) CFSTI: HC $3.00/MF $0.65

Brazing and corrosion test results are reported for 68 candidate braze alloys. A significant number of these are promising for brazing Zircaloy-clad fuel elements for pressurized water reactor application on the basis of the autoclave screening test results and some potentially promising on the basis of metallographic examination. Indications from metallographic analysis are that many of the promising systems, and some marginal ones, can be improved by appropriate thermal treatments during brazing for compositional modifications. Author (NSA)

N67-34696# Metallgesellschaft, A. G., Frankfurt am Main (West Germany).
INFLUENCE OF NEUTRON IRRADIATION ON THE MECHANICAL PROPERTIES AND THE CORROSION BEHAVIOR OF ZrNb3Sn1 AND ZIRCALOY-2
W. Spalthoff, E. Starke (G.K.S.S. mbH, Geesthacht), H. Richter, and W. Ruckdeschel Brussels, EURATOM, May 1967 37 p refs Presented at the Intern. Conf. on the Use of Zirconium Alloys in Nucl. Reactors, Pilsen, Czechoslovakia, 20–21 Oct. 1966
(Contract EURATOM-092-62-7RDD)
(EUR-3335.e; EURAEC-1795) CFSTI: HC $3.00/MF $0.65

Tensile and impact specimens were subjected to an integrated fast flux (E>1 MeV) of up to $4.5 \cdot 10^{19}$ n/cm^2 at 45°C in contact with the pool water. Corrosion specimens were irradiated in autoclaves in steam of 400°C and 100 at for up to 820 hours; in this case the maximum integrated fast flux (E>1 MeV) was $1.5 \cdot 10^{19}$ n/cm^2. For comparison, analogous tests without irradiation have been performed. The radiation caused an additional enhancement of the hydrogen uptake. The enhancement factors for the weight gains are not very well established, but there are indications that ZrNb3Sn1 is more corrosion-resistant under irradiation than Zircaloy-2. With both alloys the irradiation increases the yield strength and the ultimate tensile strength and decreases the elongation. The impact strength of ZrNb3Sn1 was increased but that of Zircaloy-2 was not essentially altered by the irradiation. The mechanical properties of both alloys reach saturation values with an integrated fast flux of about $3 \cdot 10^{19}$ n/cm^2. The recovery of radiation damage was investigated up to 450°C. While a 2 h-anneal at 300°C had no effect on the mechanical properties, a short anneal at 450°C was sufficient to eliminate the total irradiation-hardening. Author

N67-34700# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

THERMAL EVIDENCE OF A GLASS TRANSITION IN GOLD–SILICON–GERMANIUM ALLOY

H. S. Chen and D. Turnbull May 1967 14 p refs

(Contract Nonr-1866(50))

(TR-528; AD-654168) CFSTI: HC $3.00/MF $0.65

The specific heat of a splat formed amorphous alloy of gold-silicon-germanium exhibits a very steep rise with increasing temperature near 295K to a peak and then begins to fall before crystallization occurs. These last Cp values fall on a reasonable extrapolation of the high temperature Cp - T relation found for the liquid alloy. These results are attributed to a glass liquid transition in this metal system. Author (TAB)

N67-34710# Iowa State Univ. of Science and Technology, Ames.

AC SUSCEPTIBILITY OF LANTHANUM RARE EARTH ALLOYS

Thomas Stephen Prevender (M.S. Thesis) Feb. 1967 57 p refs

(Contract W-7405-ENG-82)

(IS-T-152) CFSTI: HC $3.00/MF $0.65

As ac mutual inductance technique was used to measure the differential susceptibility of La–rare earth alloys in the temperature range of 1 to 20°K. It was found that the La–Gd alloys had anomalously large susceptibilities which, at their peaks, were approximately five times as large as the susceptibility as calculated from the Brillouin function. All alloys studied (La-96–Gd-04, La-94–Gd-06, La-96–Tb-04, La-94–Tb-06, La-96–Dy-04, La-94–Dy-06) showed magnetic ordering as evidenced by a peak in their χ vs. T curves, but the ordering temperatures were lower than those that have been found for other rare earth hosts. Author (NSA)

N67-34713# Advisory Group for Aerospace Research and Development, Paris (France). Structures and Materials Panel.

COOPERATIVE PROGRAM ON MECHANICAL TESTING OF REFRACTORY METALS

D. Coutsouradis (Centre Natl. De. Rech. Met.) Mar. 1967 125 p refs

(MGRT-304)

Determinations were made of the room and high temperature tensile properties of Vascojet 90 (15CDV6) steel sheet, and the recrystallization temperature and tensile properties of TZM molybdenum alloy sheet were investigated at room temperature, 1050°, 1450°, and 1800°C. The objective of the program was to generate information on the adequacy of test techniques and specifications and also on the properties of the materials tested. The report reproduces data on the variability of test results within a laboratory and also on the interlaboratory variability. Conclusions were made as to the adequacy of test techniques. Several modifications to the original specifications were suggested. Furthermore the property variability of the materials tested was assessed as a result of the interlaboratory evaluation. Author

N67-34738*# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

ROLE OF CHLORIDE IN HOT SALT STRESS-CORROSION CRACKING OF TITANIUM-ALUMINUM ALLOYS

R. S. Ondrejcin, C. L. Selby, and S. P. Rideout Jul. 1967 16 p refs

(NASA Order R-124; Contract AT(07-2)-1)

(NASA-CR-87817; DP(NASA)-1118) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Experimental evidence obtained by the electron microprobe, mass spectrometer, and radiotracers demonstrated that the role of chloride in hot salt stress-corrosion cracking of titanium-aluminum alloys is to form HCl through a pyrohydrolytic reaction between the salt, moisture retained in the salt deposit, and the protective oxide film on the metal. The HCl subsequently reacts with the metal surface to produce the metal chloride and hydrogen. Author

N67-34788# Idaho Nuclear Corp., Idaho Falls. National Reactor Testing Station.

PERFORMANCE OF TYPES 304, 316, AND 348 STAINLESS STEEL IN NaK AT HIGH TEMPERATURES

T. L. Hoffman May 1967 11 p refs

(Contract AT(10-1)-1230)

(IN-1089) CFSTI: HC $3.00/MF $0.65

A service test examination has been made on a welded assembly containing Types 304, 316, and 348 stainless steel. This assembly had bben in NaK service for 14,200 hours at about 1000°F with the maximum temperature being 1400°F. There was no general corrosion damage on the materials. Appreciable carbide precipitation at the grain boundaries and sigma phase were observed in the Types 304 and 348 stainless steel, but only carbide precipitation in Type 316. These observations plus the results of additional evaluations indicate that the three steels are equally suitable from a corrosion standpoint for service in NaK in the temperature range and for the period report. Although significant changes were detected in the structure of the alloys, none of these suggested failure in the absence of other factors. Author (NSA)

N67-34809# Marine Engineering Lab., Annapolis, Md.

STRESS-RELIEF EMBRITTLEMENT OF AX-140 AND E-11018 WELD METALS

Alan H. Rosenstein and W. H. Asche Mar. 1967 29 p refs

(MEL-116/67; AD-653454) CFSTI: HC $3.00/MF $0.65

An attempt was made to arrive at optimum stress-relief treatments (maximum relief of residual stress with minimum increase in transition temperature) for AX-140 and E-11018 weld metals. Stress-relief of E-11018 results in acceptable toughness (although softening must be considered), whereas, stress-relief of AX-140 can produce severe embrittlement. A satisfactory thermal stress-relief treatment cannot be specified for weldments involving AX-140. Weld metal properties vary through the thickness of the weld. Center-of-weldment material is not as tough as surface material in the as-welded condition and exhibits a greater susceptibility to stress-relief embrittlement. Author (TAB)

N67-34820 Mitron Research and Development Corp., Waltham, Mass.

INVESTIGATION OF FIBER STRENGTHENED CAST COBALT-BASE ALLOYS Final Report, 14 Dec. 1966–15 Jun. 1967

J. J. Ryan and R. A. Rosenberg 15 Jul. 1967 30 p refs

(Contract NASw-1531)

(NASA-CR-87811) CFSTI: HC $3.00 CSCL 11F

The reinforcement of cobalt base alloys by randomly oriented discontinuous fibers was investigated by introducing both coated and uncoated whiskers to molten metal. The whisker materials utilized were Al_2O_3 and SiC. Melting procedures employed were induction melting under an inert gas cover and casting into graphite molds. An experiment involving high pressure arc melting in an inert atmosphere was also carried out. Microstructures of reinforced alloys were examined by light microscopy and by electron beam microanalysis techniques. Mechanical properties were determined for cobalt-base ceramic whisker composites at 1500°F and 1800°F. Author

N67-34838*# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
EFFECTS OF LIQUID AND VAPOR CESIUM ON STRUCTURAL MATERIALS
R. L. Klueh and D. H. Jansen Jun. 1967 34 p refs
(NASA Order W-12353; NASA Order R-104-(01); Contract W-7405-ENG-26)
(NASA-CR-87504; ORNL-TM-1813) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Reported are results of a literature survey on the corrosive effects of liquid and vapor cesium on structural materials which was undertaken as part of an analytical comparison of cesium and potassium as working fluids for Rankine cycle space power plants. Reviewed are studies on solubility; the corrosion of nickel- and iron-base alloys; the corrosion of refractory metals and alloys; static capsule tests (cesium vapor and liquid); dissimilar metal tests; refluxing capsule tests; loop tests (T-111/cesium natural circulation loop and Nb–1% Zr/cesium forced-circulation loops); corrosion of miscellaneous materials; and effects on mechanical properties. Compatibility tests have shown that the rates of corrosion of identical materials in cesium and potassium are qualitatively the same. It is concluded that the next step in developing the technology of cesium should logically define the specific effects of impurities on corrosion and examine the purity problems and corrosion behavior of cesium under environmental and boiling conditions which accurately simulate the fluid velocities, heat fluxes, surface-to-volume ratios, temperature distributions, and other conditions typical of the desired Rankine cycle space power plant. S.C.W.

N67-34867# Southwest Research Inst., San Antonio, Tex. Dept. of Instrumentation Research.
NONDESTRUCTIVE EVALUATION OF METAL FATIGUE Scientific Report, 1966–1967
Felix N. Kusenberger, Byron E. Leonard, John R. Barton, and W. Lyle Donaldson Apr. 1967 92 p refs
(Contract AF 49(638)-1502)
(Rept.-15-1688-2; AFOSR-67-1288; AD-653587) CFSTI: HC $3.00/MF $0.65

The purposes of this program were threefold: to design and fabricate a vacuum chamber such that specimens can be stress cycled and nondestructively monitored while in a controlled atmosphere; to develop electric current equipment for nondestructive evaluation of fatigue in nonferromagnetic metals under controlled atmosphere; and to modify existing ultrasonic and magnetic perturbation equipments such that nondestructive evaluations can be conducted in a controlled atmosphere using these techniques; to stress cycle specimens and conduct nondestructive evaluations of fatigue damage in these specimens. Photographs of the fatigue damage evaluation facility are shown including the vacuum chamber and associated equipment. Features and capabilities of the vacuum system are discussed. A description of the electric current nondestructive evaluation apparatus is given including photographs and a discussion of the technique. Modification of existing ultrasonic surface wave and magnetic perturbation equipments so that they can be used for fatigue damage evaluation in a vacuum are also described. Fatigue evaluation experiments on a steel specimen stress cycled in the laboratory ambient atmosphere are described. The results obtained utilizing the ultrasonic and magnetic nondestructive monitoring instrumentation are presented. Author (TAB)

N67-34891# California Univ., Berkeley. Lawrence Radiation Lab.
THE LOW TEMPERATURE THERMALLY ACTIVATED DEFORMATION MECHANISMS FOR BCC MAGNESIUM–LITHIUM–ALUMINUM ALLOY
Mohamed Osama Abo-el-Fotch (M.S. Thesis) Mar. 1967 38 p refs
(Contract W-7405-ENG-48)
(UCRL-17449) CFSTI: HC $3.00/MF $0.65

The effect of strain rate and temperature on the flow stress was investigated in a polycrystalline Mg–14 Li–1.5 Al(wt %) alloy. Whereas the flow stress increased only slightly as the temperature was decreased from room temperature to about 115°K, a rapid increase in the flow stress was obtained with yet greater decreases in temperature from about 115 to 20°K. The strong temperature and strain rate dependence of the flow stress below 115°K was interpreted in terms of the Dorn-Rajnak theory of the Peierls mechanism when the deformation is controlled by the rate of nucleation of pairs of kinks. Above 115°K, an athermal mechanisms is operative. Author (NSA)

N67-34900# Argonne National Lab., Ill.
HYDROGEN EMBRITTLEMENT IN IRRADIATED STEELS
A. D. Rossin Feb. 1967 73 p refs
(Contract W-31-109-ENG-38)
(ANL-7266) CFSTI: HC $3.00/MF $0.65

H_2-charging conditions that completely embrittle type 4340 high-strength steel have a negligible effect on 212-B pressure-vessel steel in tensile and delayed-failure tests. Much higher H_2 charges reduce the notch-tensile strength slightly. Delayed failure is observed only at stresses above 90% of the notch-tensile strength of the hydrogenated 212-B. Tests on 212-B that had been irradiated to give a 35% increase in strength and an NDT temperature shift of 94°C showed the same relationship between delayed-failure limits and notch-tensile strength. Catastrophic embrittlement due to H_2 (like delayed failures at 25 to 50% of the notch-tensile strength in type 4340 steel) was not observed in 212-B, even for irradiated material that had been charged to produce high H_2 contents. Therefore, catastrophic H_2 embrittlement of a well-designed nuclear-reactor pressure vessel is not believed credible. The notch-tensile strength of type 4340 steel was reduced by irradiation, although the tensile strength increased. Catastrophic delayed failure still occurred, but with the sensitivity to hydrogen slightly reduced. Author (NSA)

N67-34908# Royal Aircraft Establishment, Farnborough (England).
SOME OBSERVATIONS ON SHEAR MODE FATIGUE FRACTURE IN ALUMINIUM ALLOYS
C. A. Stubbington and P. J. E. Forsyth Aug. 1965 24 p refs
(RAE-TR-65159)

Shear mode fatigue fracture has been studied in two aluminium alloys. It was demonstrated using optical and transmission electron metallography that damage zones are produced by reversed slip ahead of shear mode fatigue cracks. Examination of shear mode fatigue fractures using fractrography, optical metallography and the Laue back reflection technique, has shown that shear mode fracture occurs on {111} planes. Author

N67-34935# General Electric Co., Schenectady, N. Y. Research and Development Center.
SUPERPLASTICITY IN LEAD–TIN ALLOYS
H. E. Cline and T. H. Alden Sep. 1966 11 p refs
(Rept.-66-C-270) CFSTI: HC $3.00/MF $0.65

A study was made of rate sensitive plastic deformation and superplasticity in alloys of lead and tin. These alloys (Pb, Pb–19% Sn, Sn–38% Pb, Sn–2% Pb, Sn) were extruded, aged at room temperautre, or melted and resolidified to produce a variety of microstructures. Flow stress versus strain rate data were obtained from tension tests for strain rates between 10^{-6} min^{-1} and 1 min^{-1}. The curve log σ versus log ϵ was S-shaped for fine-grained materials and approximately linear for course-grained materials. At constant grain size, the behavior was relatively insensitive to composition. High rate sensitivity ($d \log \sigma / d \log \epsilon$) and superplasticity occurred at intermediate strain rates in fine-grained materials and is believed to be associated with a transition with strain rate in

the mode of plastic flow. This transition was shifted to higher strain rates with increasing temperature or decreasing grain size. The high rate mechanism is presumed to be slip, while metallographic evidence suggests that the low rate mechanism is grain boundary sliding. Author

N67-35004# Societa Ricerche Impianti Nucleari, Saluggia (Italy).
INFLUENCE OF NITROGEN IN IRON AND STEEL UNDER FAST NEUTRON IRRADIATION
S. Appiano, M. Castagna, A. A. Rossi, F. S. Rossi, M. Rossi et al Brussels, Euratom, May 1967 75 p refs
(Contract EURATOM-074-65-10-TEEI)
(EURAEC-1773; EUR-3321.e)

Properties of iron alloys are cited. Summarized are the results attained with tensile tests, impact tests, fracture surface analysis and magnetic measurements on pure iron or low alloyed iron. Some details are also given about the facilities set up for the damage recovery studies and for the irradiation of the specimens at controlled temperature. Neutron spectrum influence studies are presented. The first data are quoted dealing with the works begun in order to give better information about the irradiation conditions. Neutron fluence data have been so far reported as > 1 MeV values; with the present work a better correlation with the spectrum shape will be attempted taking into account the literature references. Magnetic and mechanical properties of specimens irradiated in different reactor positions will be tested. Properties of some ASTM 212 type steels killed with Si, Al or Ti are discussed. New tests have been done to evaluate the transition temperature of these materials and a structure analysis has been also done in different heat treatment conditions. Author

N67-35066*# Syracuse Univ., N. Y.
SOLID PHASE ADHESION OF TUNGSTEN AND SILVER
William M. Saunders (M.S. Thesis) Aug. 1967 49 p refs
(Grant NsG-483)
(NASA-CR-87474) CFSTI: HC$3.00/MF$0.65 CSCL 11F

Solid phase adhesion of the bulk immiscible metals silver and tungsten has been investigated, using the method of Johnson and Keller. The strength of the junction approximated the tensile strength of silver. A model for metallic adhesion was suggested, which predicts an adhesion strength which approaches the tensile strength of the weaker metal in the couple between all pairs of metals. Author

N67-35079 Joint Publications Research Service, Washington, D. C.
EFFECT OF TITANIUM ON PHASE CONSTITUTION AND DUCTILITY OF STEEL WITH HIGH CONTENT OF BORON
R. V. Grebennikov, A. V. Chirkin, V. N. Vukolova, T. N. Shavrova, and I. S. Balanik *In its* Probl. of High-Temp. Reactor Operation 31 Jul. 1967 p 39-50 refs (See N67-35075 20-22)

The phase content effect of titanium alloyed chromium-nickel steels with 3-3.5% boron on their heat ductility have been investigated by methods of metallographic, X-ray structural, and electro-chemical analyses. An introduction of titanium leads to the formation of the boride TiB_2 and to a reduction of the amount and volume of the boride phase; a surplus of titanium leads to the formation of χ-phase type intermetallides. The intermetallide may be dissolved during thermal processing resulting in a decrease of the volume of the brittle component of the alloy and an increase of its ductility. Alloys with a 3-3.5% boron and 8-9% titanium content may after thermal processing be flattened by rolling stages up to 40%. Author

N67-35135# Aeronautical Research Labs., Melbourne (Australia).
FATIGUE OF METALS—WHERE IT STANDS TODAY
J. Y. Mann Mar. 1966 42 p refs Presented at the Metal Treatment Div., Australian Inst. of Metals, Melbourne, 4 Nov. 1965
(ARL/SM-305) CFSTI: HC$3.00/MF$0.65

Current concepts and developments in fatigue testing equipment, standardization of tests, and the determination of realistic fatigue data are discussed and reference is made to basic research and environmental effects. Consideration is also given as to how fatigue failures can be reduced by engineering design and metallurgical processing, and special reference is made to the problem of the design and treatment of welded joints. Author

N67-35148# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics
SEVENTH STUDENT SYMPOSIUM ON ENGINEERING MECHANICS
R. N. Nitzsche, J. T. Ryder, B. M. Battle, and J. A. Joyce 3 Jun. 1967 54 p refs
(T&AM-296)

CONTENTS:

1. THE VARIATION OF CRACK TOUGHNESS OF MILD STEEL WITH TEMPERATURE AND STRAIN RATE R. N. Nitzsche 10 p refs (See N67-35149 20-17)
2. A DIRECT TENSILE TEST FOR CEMENT MORTAR AND PASTE J. T. Ryder 8 p refs (See N67-35150 20-18)
3. EFFECT OF MEAN STRESS AND HARDNESS ON MAGNETIZATION INDUCED FROM CYCLIC DEFORMATION B. M. Battle 8 p refs (See N67-35151 20-17)
4. AN APPLICATION OF MIYATA'S SYNTHESIS PROCEDURE TO LINEAR MECHANICAL VIBRATION SYSTEMS J. A. Joyce 23 p refs (See N67-35152 20-32)

N67-35149# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
THE VARIATION OF CRACK TOUGHNESS OF MILD STEEL WITH TEMPERATURE AND STRAIN RATE
R. N. Nitzsche *In its* 7th Student Symp. on Eng. Mech. 3 Jun. 1967 10 p refs (See N67-35148 20-17)

The dependence of crack toughness upon temperature and strain rate is found experimentally for one type of mild steel. These results are also used to test the validity of a proposed relationship between the critical stress intensity factor, K_{Ic}, and a temperature-strain rate parameter, $T \ln(A/\dot{\epsilon})$. It was determined that crack toughness increased with increasing temperature and decreased with increasing strain rate; however, K_{Ic} was quite insensitive to both of these quantities over its range of plane strain values. The parameter $T \ln(A/\dot{\epsilon})$ did not in general give a measure of the dependence of crack toughness upon temperature and strain rate. Author

N67-35151# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
EFFECT OF MEAN STRESS AND HARDNESS ON MAGNETIZATION INDUCED FROM CYCLIC DEFORMATION
B. M. Battle *In its* 7th Student Symp. on Eng. Mech. 13 Jun. 1967 8 p refs (See N67-35148 20-17)

When a quenched and tempered steel is plastically strained it becomes permanently magnetized. The magnetization is studied as a function of the mean stress in fatigue and the hardness level. An increase in mean stress results in an increase in magnetization until the peak stress approaches the ultimate strength. Cyclic deformation induces greater magnetization than does monotonic loading to fracture. Except for the as-quenched condition increasing hardness gives increasing magnetization. Author

N67-35188 Royal Aircraft Establishment, Farnborough (England).
A COMPARISON OF THE FATIGUE BEHAVIOUR OF TWO ALUMINIUM–ZINC–MAGNESIUM ALLOYS
C. A. Stubbington and P. J. E. Forsyth Jun. 1966 32 p refs
(RAE-TR-66201)

The torsional fatigue deformation of two aluminium alloys, Al–7.5Zn–2.5Mg and Al–4Zn–5Mg, has been examined in various conditions of heat treatment. Two well defined deformation modes were observed, one in which localised transcrystalline slip produced narrow zones of precipitate re-solution, and another in which localised deformation occurred in the precipitate depleted zones at the grain boundaries. An attempt was made to correlate the torsional deformation modes of the two alloys with the fracture modes observed on rotating bending corrosion fatigue test pieces. It was found that test pieces of the Al–7.5Zn–2.5Mg alloy, subjected to torsional fatigue in certain conditions of heat treatment, exhibited localised transcrystalline deformation and precipitate re-solution, and that rotating bending test pieces in these same conditions of heat treatment exhibited extensive shear mode crack growth when fatigued in aqueous 3% NaCl solution. In the Al–4Zn–5Mg alloy there was no correlation between localised transcrystalline torsional fatigue deformation and shear mode failure on rotating bending corrosion fatigue test pieces. In the latter alloy the grain boundaries exhibited a high corrosion susceptibility and the initial shear mode growth stage was replaced by intercrystalline crack growth.
Author

N67-35256# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
THE EFFECT OF NEUTRON IRRADIATION ON THE HIGH TEMPERATURE TENSILE PROPERTIES OF SOME NICKEL-CONTAINING ALLOYS
V. B. Lawson Mar. 1967 82 p refs
(AECL-2677) CFSTI: HC $3.00/MF $0.65

Post irradiation tensile properties of Alloy 600, Alloy X-750, commerical nickel, a 70% Ni–30% Cu alloy, 304 ELC stainless steel, and two heats of a 32% Ni–21% Cr–Fe alloy have been determined at temperatures from 300° to 1000°C. The neutron dosage range from 0.25×10^{19} n/cm^2 (E>1 MeV) 1.1×10^{19} n/cm^2 (thermal) to 5.8×10^{19} n/cm^2 (E>1 MeV) 19.7×10^{18} n/cm^2 (thermal). All alloys lost ductility above approximately 550°C. This loss was not greatly affected by pre- or post-irradiation heat treatments or by the starting condition of the alloys. A strain-rate dependence of the loss was determined, but no grain size effect was evident. The strength of Alloy X-750 was affected by irradiation. Precipitation mechanisms in the irradiated solution-treated material appeared to be affected. Metallography revealed some grain boundary changes. Stress–rupture tests of two irradiated Ni–Cr–Fe alloys revealed losses of stress rupture strength and ductilities.
Author

N67-35272# European Atomic Energy Community, Ispra (Italy). Chemistry Dept.
SURFACE TREATMENT OF ZIRCONIUM ALLOYS BY OXIDIZING FUSED SALTS [TRAITEMENT DE SURFACE D'ALLIAGES DE ZIRCONIUM PAR LES SELS FONDUS OXYDANTS]
C. Hardy-Grena, A. Avogadro, and J.-G. Wurm May 1967 36 p refs In ITALIAN; ENGLISH summary
(EUR-3476.f) CFSTI: HC $3.00/MF $0.65

An oxidation coating method of Zr-alloys was improved: it consists of a thermal treatment in a fused $NaNO_3$ bath. Specimens were tested for H_2 pick-up in H_2 atmosphere and pure terphenyl; they gave favourable results. Terphenyl containing 5 ppm Cl_2 attacked alloys severely, certainly by a Cl_2 catalytic action.
Author

N67-35274# Institut de Recherches de la Siderurgie, Saint-Germain-en-Laye (France).
STUDY OF BASE METAL FOR RESEARCH ON BRITTLE FRACTURE IN LARGE WELDMENTS [ETUDE DU METAL DE BASE DESTINE A UNE RECHERCHE SUR LA RUPTURE FRAGILE DES GROS ASSEMBLAGES SOUDES]
Brussels, EURATOM, May 1967 52 p In FRENCH; ENGLISH summary
(Contract EURATOM-031-64-5 TEEF)
(EUR-3330.f; EURAEC-1788)

An intensive study of the properties of the steels which will later be tested in the form of heavy-gauge welded test-pieces is reported. Two grades of steel were studied: a nickel–chrome–molybdenum steel (Super-Elso) 130 mm thick; and a manganese–molybdenum–vanadium steel (AMMO) 200 mm thick. The principal properties studied were: mechanical characteristics (brittle-fracture and tensile strength), structural transformations, and stress-relieving. Super-Elso steel has good chemical and structural homogeneity over its thickness, but the mid-thickness and surface behave very differently as regards brittle fracture. Structural transformations and stress-relieving were therefore studied on the surface. AMMO steel has good chemical homogeneity throughout its thickness, but the brittle fracture tests (impact strength, Robertson, Pellini) show an appreciable difference between the mid-thickness and each of the surfaces. Studies on structural transformations and stress-relieving were also made on surface samples.
Author

N67-35278 Aeronautical Research Labs., Melbourne (Australia).
ACTUAL AND PREDICTED FATIGUE BEHAVIOUR OF 24S-T AND 2L.65 ALUMINIUM ALLOY NOTCHED SPECIMENS UNDER BOTH SYMMETRIC AND ASYMMETRIC RANDOM LOADING SPECTRA
J. M. Finney and A. Vann Nov. 1966 22 p refs
(ARL/SM-313)

Notched specimens of 24S-T and 2L.65 aluminium alloy were tested in axial loading under random loading conditions representative of both symmetric and asymmetric spectra. The endurances predicted using three empirical hypotheses for reducing the complex load sequences into load cycles of constant amplitude have been compared with those obtained experimentally. None of these hypotheses led to consistent or close prediction of the experimental endurances. If, for simplicity, one hypothesis is to be used, the peak-to-trough method (H_1) is preferred because of its tendency towards conservative prediction. The experimental life under the asymmetric spectrum was about one-half that under the symmetric spectrum but predictions of life were more conservative for the asymmetric case. The results also indicate that, for a given hypothesis, the experimental lives of both materials are equally well predicted.
Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N67-34002 Royal Aircraft Establishment, Farnborough (England).
GLASS TRANSITION TEMPERATURES AND THERMAL COEFFICIENTS OF CUBICAL EXPANSION OF POLY(DI-ISOPROPYLIDENEGALACTOSE ACRYLATE) AND POLY(DI-ISOPROPYLIDENEGALACTOSE METHACRYLATE)
J. H. Sewell Feb. 1967 13 p refs
(RAE-TR-67041)

The glass transition temperatures (T_G'a) of two new synthetic derivatives of galactose, poly(di-isopropylidenegalactose acrylate) and poly(di-isopropylidenegalactose methacrylate), were measured with an automated dilatometric apparatus and found to be 98°C and 126°C, respectively. Coefficients of cubical expansion, below and above the T_G, were 0.99×10^{-4}/°C and 6.35×10^{-4}/°C for the acrylate, and 3.93×10^{-4}/°C and 12.12×10^{-4}/°C for the methacrylate. The magnitude and relationship between the T_G values and the polymer structures are discussed with special reference to other acrylates and methacrylates. Author

N67-34008# Avco Corp., Lowell, Mass. Space Systems Div.
MICROSTRUCTURE STUDIES OF POLYCRYSTALLINE REFRACTORY OXIDES Summary Report, 25 Mar. 1966–24 Apr. 1967
Arthur H. Heuer, William H. Rhodes, David J. Sellers, and Thomas Vasilos 24 Apr. 1967 119 p refs
(Contract NOw-66-0506-d)
(AVSSD-0211-67-RR; AD-653483) CFSTI: HC $3.00/MF $0.65

Hot working polycrystalline alumina, utilizing a press forging technique, was extensively investigated. Primary recrystallization followed the working and resulted in either single crystals (strain-anneal technique) or relatively fine-grained structures. The basal texture present after recrystallization was identical to the deformation texture; this and the equiaxed recrystallized structures suggested that oriented nucleation was important. At larger grain sizes, an elongated grain structure was observed and was attributed to oriented growth. The marked basal texture suggested that basal slip was the predominant deformation mode; the probability of other deformation mechanisms was also discussed. Addition of 1/4% MgO retarded recrystallization and a number of such samples, possessing a pronounced basal deformation texture, were used for mechanical properties determination. The working led to no less of structural integrity, and the strength was surprisingly constant with grain size, at least in the range 3.5-10.5 microns. The larger-grained worked samples were stronger than hot-pressed samples of equivalent porosity and grain size. The high ductility, up to 75% height reduction being achieved without much difficulty, suggested that hot working could be used to produce shaped bodies. Author (TAB)

N67-34098# Harwell (England). Ceramics Div.
THE PREPARATION OF PLUTONIUM CONTAINING SAMPLES FOR ELECTRON PROBE MICROANALYSIS
H. E. Chamberlain and D. J. Hodkin May 1967 10 p refs
(AERE-M-1889) CFSTI: HC $3.00/MF $0.65

Techniques for the metallographic preparation and subsequent decontamination of a variety of plutonium containing samples to be examined by electron probe microanalysis, are described. Surface and geometry requirements for these samples are defined. Illustrations of the standard holder used for the samples, the method of mounting samples in the holder, and the method of mounting both machined and brittle samples, are presented. L.S.

N67-34101 Atomic Energy Establishment, Trombay (India).
COMPATABILITY STUDIES ON APCODUR-22 WHITE—AN EPOXY BASED PAINT
M. H. Rao, L. V. Shastry, S. B. Srivastava, and K. V. S. Rama Rao 1967 14 p refs
(AEET-274) CFSTI: HC $3.00/MF $0.65

Compatability studies were conducted on "Apcodur-22 White" to assess its suitability for use on the lid of Zerlina, a low energy swimming pool type reactor employing heavy water. The epoxy paint samples in contact with water were stable up to 5×10^5 rads and as such could be used safely below this dose only. However, the residual solvents are capable of getting autoxidized and decrease the p^H even in the absence of a radiation field. In the presence of radiation this oxidation is further accelerated. In both cases the final p^H is estimated to be about 4. The p^H depression could lead to serious corrosion of materials like iron. Also, if epoxy paints are used to paint tanks for storing heavy water, isotopic dilution of the stored heavy water would result. This can be overcome by pre-equilibrating the paint with heavy water. R.N.A.

N67-34133# Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.
FLUOROCARBON NITRIDE ELASTOMERS Final Report, 8 Mar. 1966–8 Mar. 1967
Robert A. Falk 8 Mar. 1967 70 p refs
(Contract NOw-66-0289-c)
(RMD-5086-F; AD-653432) CFSTI: HC $3.00/MF $0.65

The search for an improved heterofluorocarbon elastomer is described. The synthesis of a number of new fluorimine monomers led to the useful monomer - perfluoroisopropylidenimine, $(CF3)2C=NF$. It was successfully copolymerized with tetrafluoroethylene by gamma- irradiation to yield a copolymer which melts to a free-flowing liquid at 270-280C. Preliminary characterization of this copolymer is described. The new compounds, perfluoro-1,4diazabutadiene-1,3, 3, perfluoro-1, 4-diazabutene-1, and N-fluoro-N-sec-perfluoropropyldiazine-N-oxide, are reported. The diene shows no useful monomer reactivity. Attempts to prepare N-fluoro and N-trifluoromethyl perfluoroaziridine monomers are reported. Author (TAB)

N67-34250# Picatinny Arsenal, Dover, N. J. Plastics Technical Evaluation Center.
MILITARY APPLICATIONS OF PLASTICS AND RELATED MATERIALS
Arthur H. Landrock and Nicholas T. Baldanza May 1967 34 p refs
(PLASTEC Note-16; AD-653837) CFSTI: HC $3.00/MF $0.65

Plastics, elastomers, polymeric coating materials, adhesives and sealants are rapidly increasing in importance for use in military applications. The report gives a to-date review of these uses. Included in the discussion are plastics applications in such end items as vehicles, weapons and missiles, armor and ammunition, shelters and buildings, packs and containers, and medical-surgical devices. The bibliography consists of 59 items. Author (TAB)

N67-34304# Pennsylvania State Univ., University Park. Materials Research Lab.
RELATION OF MECHANICAL PROPERTIES TO THE STRUCTURE OF IONIC SOLIDS Quarterly Report
K. Vedam and V. Vand Watertown, Mass., Army Mater. Res. Agency, 15 Jun. 1967 38 p refs
(Contract DA-19-0660-AMC-325(X))
(AMRA-CR-66-07/4; QR-4; AD-653788) CFSTI: HC $3.00/MF $0.65

The crystal structure analysis and least squares refinement of fluorophlogopite (R-factor = 6.4%) was completed in the centric space group C2/m utilizing Hansons relative weighting scheme. The interatomic distances and thermal vibration amplitude features of the mica have been determined utilizing these refined parameters. N(Z) tests on the mica intensity data for a center of symmetry suggest the possibility that the material may be noncentric; a study has been started in this respect. The use of absolute, semi-absolute and relative weighting schemes in least squares refinements with anisotropic vibration parameters is discussed with reference to a study on ruby. The Berg-Barrett x-ray technique was successfully employed to delineate the dislocations in the (001) plane of mica. Author (TAB)

N67-34334# Melpar, Inc., Falls Church, Va.
IMPROVEMENT OF TEAR RESISTANCE OF COATED FABRICS Final Technical Report, 3 Feb. 1966–1 Feb. 1967
B. S. Fisher Feb. 1967 48 p Feb. 1967 48 p refs
(Contract DA-44-009-AMC-1487(T))
(AD-663792) CFSTI: HC $3.00/MF $0.65

A series of 2 oz/sq yd, plain-weave nylon fabrics of varying thread count and degree of yarn twist impregnated with varying amounts of two standard primer-adhesive formulations were mechanically tested to determine the relative importance of fabric construction and primer compound variables in tear strength retention of coated fabrics. Primer modulus, amount of primer deposited and degree of yarn twist were found to be important initially. The loss of tear strength of the primer-treated fabrics was found to be due mainly to the immobilization of the fabric yarns by virtue of the bonding action of the primer compound at their points of intersection. The strength of this bond appeared to be a direct measure of the restraining force responsible for the yarn immobilization and was determined by means of a yarn pullout test developed for this purpose. The degree of restraint necessary to cause loss of fabric tear strength was found to be quite small. The additional restraint imposed by subsequent application of coating compound to the fabrics in a manner which allowed complete penetration was so great as to overshadow all other effects, even when the coating compound modulus was minimized by undercuring, and coating adhesion was low. Good tear strength retention at a low rate of tear was achieved with a composite coating embodying a modulus gradient, such that uncured elastomer filled the fabric interstices. Author (TAB)

N67-34364# Liege Univ. (Belgium). Institut de Chimie et Physique Nucléaires.
RESEARCH FOR AND SYNTHESIS OF A THERMOSTABLE MATERIAL OF HIGH ISOTOPIC HYDROGEN CONTENT, AND FABRICATION OF A NEW TARGET FOR NEUTRON PRODUCTION IN ACCELERATORS [RECHERCHE ET SYNTHESE D'UN MATERIAU THERMOSTABLE A HAUTE TENEUR EN HYDROGENE ISOTOPIQUE ET FABRICATION D'UNE NOUVELLE CIBLE POUR LA PRODUCTION DE NEUTRONS DANS LES ACCELERATEURS]
J. M. Peeters and M. A. Guillaume Brussels, EURATOM, May 1967 76 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-050-63-8 RISB)
(EUR-3474.f) CFSTI: HC $3.00/MF $0.65

With a view to improving the characteristics of the present tritium targets used for 14 MeV neutron production, research was undertaken with the aim of developing a target of novel design, composed of a high polymer in which the tritium forms an integral part of the molecule. The material chosen for the task was the polyphenyl $(C_6H_4)_n$, a thermostable polymer that can tritiated by direct synthesis using the T_2 gas isotope. A deuterated polyphenyl target was produced after the main stages had been prepared as follows: (1) quantitative microsynthesis of the polyphenyl from benzene, (2) study of isotope yield from polymerizing of the dueterated benzene, (3) quantitative microsynthesis of benzene, (4) development of a mechanical process for fabricating thin homogeneous layers of polyphenyl on metal support. The development work on these different stages was carried out on hydrogenated and deuterated compounds. The thermal behavior of this type of target under deuteron irradiation shows better performance than those of metal targets. The study of high specific activity tritiating of polyphenyl, as also measurements of the neutron fluxes obtained from tritiated targets, will be reported in subsequent publications. Author

N67-34414 Royal Aircraft Establishment, Farnborough (England).
THERMAL DEGRADATION OF POLYMERIC MATERIALS IN OXYGEN. PART 7—POLYMERS WITH AROMATIC RINGS IN THE CHAIN
Joyce M. Lancaster and W. W. Wright Nov. 1966 14 p refs
(RAE-TR-66353)

The thermal degradation in oxygen of 15 polymers containing aromatic rings in the chain has been studied by a weight loss method. The relative thermal stabilities of the different polymers have been determined and, where possible, the overall activation energy for breakdown. The results have been compared with those for samples of the same polymers degraded in vacuum. The most thermally stable of the polymers was poly(2,5-dichlorophenylene oxide), with a stability comparable with that of a copolymer of tetrafluoroethylene and hexafluoropropylene. Author

N67-34424# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
REDUCTION BEHAVIOR AND SELECTED PROPERTIES OF ALUMINA–CERIA COMPOSITIONS
T. S. Stanislaw Jul. 1967 31 p refs
(RE-297)

In an exploratory study of ceramic compositions in the alumina–ceria system, high density ceramic specimens were prepared from both pure alumina and pure ceria and from five mixtures containing 2.0, 5.0, 23.0, 42.0 and 62.8 weight percent (w/o) ceria. Measurements were made of properties of interest to aerospace applications—of thermal conductivity, modulus of rupture and dielectric constant. The specimens were examined visually after thermal treatment to detect oxygen loss, and both X-ray diffractometry and differential thermal analysis provided information on reactions between alumina and ceria. The results of the investigation are discussed. Author

N67-34442# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
LOW-VOLTAGE RADIOGRAPHY AND MICRORADIOGRAPHY OF GRAPHITE
R. W. Mc Clung [1967] 18 p refs Presented at the 70th Ann. Meeting of the Am. Soc. for Testing and Mater., Boston
(Contract W-7405-ENG-26)
(ORNL-P-3019; CONF-670605-1) CFSTI: HC $3.00/MF $0.65

Low-voltage radiography was studied to provide optimum techniques for graphite thicknesses of less than 2 in. Significant improvements were made in image quality and sensitivity by use of an intermediate atmosphere of He, bare film, and a thin Be-window X-ray tube. Use of a high resolution photographic emulsion allows contact microradiography to be performed on miniature specimens with a resolution of one micron. Author (NSA)

N67-34450# Atomic Weapons Research Establishment, Aldermaston (England).
OVERLAP PROBABILITY OF FLAWS IN A LAMINATED DIELECTRIC
W. Held and R. J. Klahn Mar. 1967 21 p refs Transl. into ENGLISH from Elektrotech. Z., Issue A (Berlin), v. 87, no. 4, 18 Feb. 1966 p 121–126
(AWRE-TRANS-53) HMSO: 3s

The individual layers of highly stressed electrical insulation contain flaws such as conducting inclusions and pinholes. The probability of two, three, or more such flaws overlapping is calculated. In the dielectric of capacitors, overlaps of two flaws occur with a probability of 10^{-5} to 10^{-3} per m^2, while overlaps of three

or more particles are highly unlikely. Results from power capacitor tests are compared with the calculated overlap probability of conducting inclusions in the paper. The technique used enables an estimate to be made of the test failure in capacitors with three layers of insulating material, provided the number of flaws in the paper is known. R.N.A.

N67-34526# AiResearch Mfg. Co., Phoenix, Ariz.
BERYLLIDE COMPOSITION 1, 2400-DEGREE TURBINE MATERIALS RESEARCH PROGRAM Summary Test Report
R. B. Scott 17 Jan. 1967 78 p
(Contract DA-44-177-AMC-183(T))
(MP-5242-R; AD-653632) CFSTI: HC $3.00/MF $0.65

The report summarizes the results of tests conducted on beryllide Composition 1 specimens during performance of the 2400-degree turbine/materials research program. The information contained herein is intended for presentation to U. S. Army Aviation Materiel Laboratories to show compliance with Contract DA44-177-AMC-183(T). The tests conducted include tensile, impact, stress-rupture, creep, thermal fatigue, oxidation, oxidation-sulfidation, and physical properties tests. Author (TAB)

N67-34616 Royal Aircraft Establishment, Farnborough (England).
COMPARATIVE INVESTIGATIONS OF DIFFERENT TECHNIQUES FOR CHARACTERISATION OF THE BEHAVIOUR OF REINFORCED AND NON-REINFORCED POLYESTER RESINS SUBJECTED TO HEAT [VERGLEICHENDE UNTERSUCHUNGEN UBER VERSCHIEDENE VERFAHREN ZUR CHARAKTERISIERUNG DES VERHALTENS VON VERSTARKTEN UND UNVERSTARKTEN POLYESTERHARZEN IN DER WARME]
K. Demmler May 1967 30 p refs Transl. into ENGLISH from Kunststoffe-Plastics (Solothurn), v. 55, no. 12, 1965 p 929–937
(RAE-LIB-TRANS-1234)

Measurement of torsional modulus and the logarithmic decrement of mechanical damping are compared with various single point methods for assessing the heat resistance of polyester resins, with and without reinforcement. The former method also allows conclusions to be drawn regarding the state of cure of the material. Author

N67-34672* Avco Corp., Tulsa, Okla. Avco Electronics Div.
MATERIALS EVALUATION FOR SERVICEABILITY OF OPTICAL GLASSES UNDER PROLONGED SPACE CONDITIONS Final Report, Jul. 1965–Jun. 1967
W. R. Holland Jun. 1967 73 p refs
(Contract NAS9-4845)
(NASA-CR-65687; TR-67-G-109-F) CSCL 11B

Samples of prospective Apollo window materials were exposed to temperature cycles of +250°F to −250°F and solar simulation approximating the Johnson spectrum. Two ninety-day tests were conducted. The purpose of the test was to determine the optical degradation resulting from exposure with periodic measurements of the spectral transmittance. Considerable degradation was found to occur in the plastics and polymers with no observable degradation occurring in the glasses. Spectral transmittance curves of each material, made *in situ*, are presented for the two ninety-day tests. Author

N67-34684# Royal Aircraft Establishment, Farnborough (England).
CARBON FIBRE REINFORCED PLASTICS—AN INITIAL EVALUATION
L. N. Phillips Apr. 1967 33 p refs
(RAE-TR-67088) CFSTI: HC $3.00/MF $0.65

The R.A.E. carbon fibre is shown to be compatible with a wide range of thermosetting polymers and techniques are described for incorporating useful volume fractions of fibre into resin-bonded composites. Several important mechanical and physical properties have been measured; the good strength and very high specific stiffness predicted from the fibre properties have been confirmed. A number of favorable potential applications for carbon-fibre plastics are discussed and an outline is given of the future program of development. Author

N67-34697# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
FEASIBILITY OF DISPERSED PHASE GRAIN REFINEMENT IN CERAMICS
J. L. Woolfrey Feb. 1967 27 p refs
(AAEC/E170) CFSTI: HC $3.00/MF $0.65

The feasibility of dispersed phase grain refinement in ceramics is assessed. Conditions for grain size stabilization of normal grain growth are derived using a Zener type analysis for random dispersions and for the case in which all particles are located at specific sites upon a grain boundary. The calculations predict the relative stabilizing effects of particles located at grain boundaries, triple-grain edges and four-grain corners. Other factors reviewed include the effects of particle size instability, nucleation of discontinuous grain growth, and possible methods for its prevention. It is concluded that dispersed phase grain refinement in ceramics is feasible. The general predictions are applied to the case of a BeO moderator and used to predict the most promising additives for further investigation. Author

N67-34753 Central Lab. Tno, Delft (Netherlands).
MECHANICAL PROPERTIES OF HIGHLY FILLED ELASTOMERS. VI. INFLUENCE OF FILLER CONTENT AND TEMPERATURE ON ULTIMATE TENSILE PROPERTIES
Cornelium J. Nederveen and Hendricus W. Bree May 1967 43 p refs
(Contract N62558-4375)
(CL-67/34; ONR-6)

Results are presented of stress-strain tests performed at various temperatures and strain rates on materials filled with various amounts of sodium chloride particles with a mean size of C.1 mm. Stress and strain at rupture decreased with increasing filler content. For each material investigated it was possible to construct the well-known failure envelope by means of which the results could be described adequately. The dewetting of the particles in the rubbery matrix, sometimes resulting in a maximum in the stress-strain curve, is ascribed to failure of the rubber between the particles and not to failure of the rubber-salt bond, because the dewetting maximum was dependent on temperature and time in the same way as the rupture properties of the unfilled material. The results are compared with earlier investigations, e.g. high speed tensile tests and creep experiments, and a good agreement is found. Author

N67-34769*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
POLYMER RESEARCH
In its Space Programs Sum. No. 37–45, Vol. IV 30 Jun. 1967 p 92–108 refs (See N67-34761 20-30)

Polyurethane elastomers based on castor oil were characterized for network chain concentration, chain flexibility, and polymer solvent interaction parameters. The interaction parameter was determined in benzene, ethylene dichloride, cyclohexane, heptane, and isooctane. The structure–property relationships for polymers were examined in relation to the influence of the chemical nature of an elastomer on stress–strain response. It is pointed out that the controlling parameter is the chain flexibility which can be expressed in terms of the molecular volume of a statistical chain

segment. Experiments continued on determining the suitability of thermoplastic rubbers as binders for composite solid propellants. Chemical modifications of the thermoplastic molecule, to increase the adhesive bond between the filler and the rubber, are described. The relationship between stress and strain in multiaxial deformations of elastomers is assessed, and a method for measuring the internal gas pressure of rigid closed-cell foam is discussed. Poly(isobutylene) prepolymer research is summarized. Experimental details are given on measurements made to determine the effect of foam structure geometry on the dielectric strength of rigid urethane foam. M.G.J.

N67-34790# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
THE CREEP OF ISOSTATICALLY-PRESSSED BERYLLIUM OXIDE
J. W. Kelly May 1967 16 p refs
(AAEC/E176)

The creep in bending of polycrystalline isostatically-pressed beryllium oxide has been studied in the temperature range 800°C to 1150°C for stresses up to 10^4 lb in^{-2}. The minimum creep rate was found to be linearly proportional to stress and the process was temperature-dependent with an activation energy of 100 kcal $mole^{-1}$. Thus results were consistent with the Nabarro–Herring creep mechanism, the rate constant being 10^{-8} to 10^{-9} lb^{-1} in^2 h^{-1}. Probably the creep rate is controlled by an impurity and would be enhanced by neutron irradiation. Author

N67-34799# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
COLD PRESSING AND SINTERING OF RARE EARTH OXIDES
H. T. Fullam and L. J. Kirby Apr. 1967 28 p refs
(Contract AT(45-1)-1830)
(BNWL-386) CFSTI: HC $3.00/MF $0.65

Sm_2O_3 was cold pressed to densities in excess of 80% of theoretical (6.21 g/cm^3) by standard pressing techniques. Strength limitations of the dies and plungers used prevented pressing at pressures above 102 TSI. If better dies were designed so higher pressures could be used, higher cold press densities should be possible. Alternatively, if the Sm_2O_3 was calcined at temperatures above 1500°C, the cold press density should increase. Sinter densities as high as 95.6% of theoretical (7.40 g/cm^3) were obtained with Sm_2O_3 which had been cold pressed to maximum density. The optimum sintering conditions were not determined. NSA

N67-34866 National Research Council of Canada, Ottawa, (Ontario). Associate Committee on Bird Hazards to Aircraft.
TESTS ON THE BIRD-IMPACT RESISTANCE OF POLYURETHANE FOAM
H. S. Fowler Feb. 1967 11 p refs *Its* Field Note No. 44
(CM4-S-17-2)

In a general discussion on the protection of aircraft structures against bird-impact, it has been suggested that a deep layer of plastic foam might form a good protection. Samples of plastic foam were therefore tested against 1 lb. and 2 lb. dummy "birds", fired from an airgun at 420 and 360 ft/sec respectively, the foam being both in the open and enclosed in an aircraft tailplane. The results of these experiments show how much protection was offered by the arrangements tested. Author

N67-34937 Central Lab. TNO, Delft (Netherlands).
MECHANICAL PROPERTIES OF HIGHLY FILLED ELASTOMERS VI. INFLUENCE OF FILLER CONTENT AND TEMPERATURE ON ULTIMATE TENSILE PROPERTIES
C. J. Nederveen and H. W. Bree May 1967 53 p refs
(Contract N62558-4375)
(CL-67/34; TR-6)

Results are presented of stress–strain tests perfprmed at various temperatures and strain rates on materials filled with various amounts of sodium chloride particles with a mean size of 0.1 mm. Stress and strain at rupture decreased with increasing filler content. For each material investigated it was possible to construct the well-known failure envelope by means of which the results could be described adequately. The dewetting of the particles in the rubbery matrix, sometimes resulting in a maximum in the stress–strain curve, is ascribed to failure of the rubber between the particles and not to failure of the rubber–salt bond, because the dewetting maximum was dependent on temperature and time in the same way as the rupture properties of the unfilled material. The results are compared with earlier investigations, e.g. high speed tensile tests and creep experiments, and a good agreement is found. Author

N67-35038# West Virginia Univ., Morgantown.
RADIATION INDUCED POLYMERIZATION OF VINYL MONOMERS IMPREGNATED IN WOOD
J. A. Kent, G. B. Taylor, W. R. Boyle, and A. W. Winston [1966] 17 p refs Presented at the Am. Inst. of Chem. Engr. Symp., Detroit, 8 Dec. 1966
(Contract AT(40-1)-2945)
(ORO-2945-8; CONF-661201-3) CFSTI: HC $3.00/MF $0.65

The effects of radiation intensity on conversion rates and the quantity of radiation required for complete polymerization of monomers in wood were investigated. The monomers used were methyl methacrylate, ethyl acrylate, styrene, acrylonitrile, and ethyl acrylate–acrylonitrile, styrene–acrylonitrile, and Phosgardmethyl methacrylate systems. The results indicated that the gamma radiation dose required for complete polymerization of the monomer systems sutided in a variety of woods was a function of the 0.3 power of radiation intensity. However, with pine resins an inhibitory effect was found. NSA

N67-35040# Oak Ridge National Lab., Tenn. Reactor Div.
DETERMINATION OF THE FRACTURE TOUGHNESS OF EGCR-TYPE AGOT GRAPHITE
J. M. Corum Dec. 1966 45 p refs
(Contract W-7405-ENG-26)
(ORNL-4030) CFSTI: HC $3.00/MF $0.65

A step was taken toward the application of fracture mechanics concepts to the design of graphite components to prevent brittle fracture. Tests were performed on notched bend specimens of EGCR-type AGOT graphite, and the results were used to determine values of G_c, the critical rate of strain-energy release. Relationships established both by the theory of elasticity and by experimental compliance testing were used. The specimens were beams with a single, lateral, artificial crack cut with a jeweler's saw. The critical rate of strain-energy release for specimens oriented parallel to the axis of extrusion of the material was found to be approximately 0.39 in.-lb/$in.^2$, and for specimens oriented transverse to the axis of extrusion the value was approximately 0.29 in.-lb/$in.^2$. G_c values based on the analytical and compliance analysis relationships were in good agreement. Results indicated that the concept of a critical strain-energy release rate being a condition for rapid crack propagation applies to graphite. However, the final proof can come only from the successful application of fracture mechanics to a component with a geometry and loading widely different from that of the laboratory specimen. Author (NSA)

N67-35096# Sandia Corp., Albuquerque, N. Mex.
PROCESSING CONDITIONS AND THEIR EFFECTS ON THE DIMENSIONAL BEHAVIOR OF PRECISION MOLDINGS. IV: GLASS-FILLED CELCON PARTS
C. E. Roebuck (Bendix Corp., Kansas City, Mo.) and P. J. Thoma Apr. 1967 78 p refs
(Contract AT(29-1)-789)
(SC-DR-67-81) CFSTI: HC $3.00/MF $0.65

Data regarding dimensional behavior of 30% glass-filled Celcon molding material as a function of five independent variables (mold temperature, melt temperature, injection pressure, press closed time, and annealing time) and various environmental conditioning procedures are presented. Mold temperature and annealing procedures were found to be significant in producing dimensionally stable parts. Filled material exhibited less resistance to flow than unfilled Celcon, indicating that the filler caused an increase in flow at lower pressures. Optimal molding conditions for all variables studied were determined statistically. Author (NSA)

N67-35097# Sandia Corp., Albuquerque, N. Mex.
EFFECT OF A POLYSULFIDE RUBBER ON THE ELECTRIC STRENGTH OF AN EPOXY RESIN
C. W. Boots Apr. 1967 10 p refs
(Contract AT(29-1)-789)
(SC-TM-67-50) CFSTI: HC $3.00/MF $0.65

Electrical strength test specimens of the Rogowski contour were made with two epoxy resins and a polysulfide rubber. With Epon 828/Z cured epoxy-polysulfide rubber composite, breakdown strength was approximately the normal value while for SRIR-polysulfide composite there was a degrading effect of the polysulfide on the composite strength. This could have been caused by breakdown initiation in the polysulfide or a chemical surface effect of the polysulfide on the polymerization of the SRIR. Author (NSA)

N67-35150# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
A DIRECT TENSILE TEST FOR CEMENT MORTAR AND PASTE
J. T. Ryder *In its* 7th Student Symp. on Eng. Mech. 3 Jun. 1967 8 p refs (See N67-35148 20-17)

A direct tensile test is described for mortar and cement paste. Cylindrical specimens are cast with metal end collars. One end is threaded onto the load cell of the testing machine, and the other end is immersed in a liquid–solid grip which reduces misalignment and avoids clamping distortions. This testing method has several advantages over previously developed methods. Preliminary tensile strength results are obtained and those for paste are compared with split cylinder test results. Author

N67-35166# General Electric Co., Schenectady, N. Y. Research and Development Center.
ANALYSIS OF THE NATURE OF GRAIN BOUNDARIES IN CERAMICS
J. H. Westbrook Sep. 1966 15 p refs
(Rept.-66-C-308)

The analytical methods that give direct insight to the structure and chemistry of grain boundaries in polycrystalline ceramics are reviewed. Examples are given of the new understanding of ceramic grain boundaries made possible by these techniques. Author

N67-35186 Royal Aircraft Establishment, Farnborough (England).
HIGH-SPEED ABRASION OF TEXTILE CORDAGE ON AN ASPHALT SURFACE
J. E. Swallow and M. W. Webb Jan. 1967 21 p refs
(RAE-TR-67023)

Braided cordages of nylon, polyester and polypropylene fibres were abraded at high speed on an asphalt surface. Two complementary methods of testing were shown to be suitable for comparing different textiles, textile treatments and abrading surfaces. In one series of tests, the velocity, tension and time of abrasion were varied factorially, and the residual breaking strengths of the cordages were compared with results obtained with a concrete surface. In a second series, the effects of velocity and tension on failure-time were determined; experimental simplification was achieved, and no limit imposed on the severity of the conditions. Author

N67-35187 Royal Aircraft Establishment, Farnborough (England).
THE WATER ABSORPTION OF AN UNSATURATED POLYESTER RESIN AND GLASS-FIBRE/RESIN COMPOSITES
N. C. W. Judd Feb. 1967 19 p refs
(RAE-TR-67042)

Water absorption measurements have been made on a cast unsaturated polyester resin and glass-fibre/resin composites at various temperatures. The results were analysed by diffusion and capillary flow equations. Water appeared to enter the resin by a diffusion process. The diffusion coefficients at different temperatures were calculated and an activation energy for the process determined. In glass-fibre composites it appeared that both diffusion and capillary processes were in operation, but that the effect of the diffusion process was reduced by the presence of fibres. Author

N67-35208 Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
A NUMERICAL SOLUTION FOR THE SINGLE-SCREW EXTRUSION OF A POLYMER MELT
D. F. Dyer Jun. 1967 33 p refs
(SF/TN/8)

A general numerical analysis procedure is presented for the screw extrusion of a nonNewtonian material. The full Navier–Stokes, energy and continuity equations are used in the numerical procedure. The flow is taken as steady and incompressible and the viscosity is written according to the Ostwald–de Waele model in which the viscosity is assumed inversely proportional to the square root of the second invariant of the rate of deformation tensor and exponentially dependent on the temperature. The procedure allows the prediction of vorticity, stream-function, swirl velocity, internal energy and viscosity over any cross section of a groove containing plastic. Calculations for the mass extrusion rate and power consumption (shear rate) for the screw extruder are also given. Typical cases are considered for which all the quantities listed above are determined. The results compare favorably with other theoretical work. Author

N67-35269# Institut Franco-Allemand de Recherches, St. Louis (France).
MECHANICAL AND DETONATION PROPERTIES OF RUBBER BONDED SHEET EXPLOSIVES
W. Kegler and R. Schall 30 Sep. 1965 18 p refs
(ISL-T-36/65)

Different methods for the manufacture of flexible sheet explosives containing PETN as the explosive component bonded with 10–20% rubber are described. The mechanical characteristics of these compositions (tensile strength, elongation at break, flexibility) are also given. At a density of 1.4 g/cm^3, the detonation

rate is 7000 m/s, but by introducing porosities, much lower detonation velocities can be obtained. The detonation velocity decreases drastically when the sheet explosive is stretched. This reduction in velocity is induced by a decrease in density which is typical for rubbers containing fillers. This effect may be used for continuous control of the detonation rate. Kerr-cell photographs taken of detonating sheets with one-dimensional elongation (up to 130%) show anisotropy in the detonation rate which increases with the applied tension. The detonation rate along the axis under tension becomes appreciably higher than in the normal direction. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N67-34019# Naval Postgraduate School, Monterey, Calif.
BAYESIAN METHODS AND RELIABILITY GROWTH
Harold J. Larson Mar. 1967 33 p refs
(TR/RP-78; AD-653460) CFSTI: HC$3.00/MF$0.65

A particular model is proposed for reliability growth and a prior distribution is assumed on the parameters. Various statements regarding the final reliability are then derived; a numerical example is included. TAB

N67-34053# Stanford Univ., Calif. Dept. of Statistics.
BOUNDS ON THE EFFICIENCY OF A CLASSIFICATION PROCEDURE
Herman Chernoff 16 Jun. 1967 23 p ref
(Contract Nonr-225(72))
(TR-56; AD-653724) CFSTI: HC$3.00/MF$0.65

In a study of character recognition Dolby found it convenient to replace linear discriminant functions by simpler functions consisting of sums of some of the observations. In the cases studied the efficiency of these more convenient sums were remarkably high. This paper discusses circumstances where bounds may be derived on the efficiency of the use of sums. TAB

N67-34065# Rocketdyne, Canoga Park, Calif.
RESULTS ON NON-ORTHOGONAL INCOMPLETE FACTORIAL DESIGNS Interim Scientific Report
Steve R. Webb Wright-Patterson AFB, Ohio, ARL, Feb. 1967 65 p refs
(Contract AF 33(615)-2818)
(ARL-67-0021; AD-653592) CFSTI: HC$3.00/MF$0.65

The report consists of three distinct but related papers. The first is concerned with methods for constructing designs to meet realistic requirements on the number of runs and with criteria for selecting a design from a number of alternatives. Examples of various construction techniques are illustrated and designs are given which were constructed for actual experiments. Two specific numerical criteria are developed, and a convenient computer routine for evaluating them is described. The second paper discusses designs of even resolution. It is shown that the smallest resolution 4 designs for n factors at two levels must contain at least 2n runs, and that foldover designs are available with 2n runs. It is conjectured that the only minimal resolution 4 designs are foldover designs. The case of resolution 6 designs is also discussed. The third paper gives the variance bounds for estimates of main effects using one-at-a-time designs, and characterizes those designs which achieve the lower bounds. Situations in which runs are conducted a block at a time (rather than singly) are treated and it is shown that inclusion of interaction terms in the model improves the main-effect estimates of factors involved in the interactions. Author (TAB)

N67-34089# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
THEORY AND TABLES FOR TESTS OF HYPOTHESES CONCERNING THE MEAN AND THE VARIANCE OF A WEIBULL POPULATION Final Scientific Report
H. Leon Harter and Satya D. Dubey (Ford Motor Co.) Mar. 1967 401 p refs
(ARL-67-0059; AD-653593) CFSTI: HC$3.00/MF$0.65

A summary is given of the current state of knowledge concerning the analysis of data arising from Weibull populations. Five different parameterizations which have been used by various authors are given, and the relation of the various sets of parameters to each other and to the mean and the variance is explored. It is shown that the standardized cumulants are functions only of the shape parameter. An auxiliary table is given of the mean and the variance of a Weibull population with location parameter 0 and scale parameter 1 and of the standardized cumulants gamma sub k (k = 3,4,...,8), all for shape parameter m = 1.1(0.1)10.0. The theory is developed for tests of hypotheses concerning the mean and the variance of a Weibull population, based on the Weibull-Z, Weibull-T, and Weibull-V statistics, which are analogues of the normal-z, Student-t, and (chi square)/(degrees of freedom) statistics, respectively, the difference being that the underlying distribution is Weibull rather than normal. Percentage points of the Weibull-Z statistic are worked out by use of the Cornish-Fisher expansion technique and similar results for the Weibull-V and Weibull-T statistics are obtained by means of a Monte Carlo simulation. The percentage points are tabulated for all combinations of the above values of m; sample sizes n = 2(1)40, 48, 60, 80, 120, 240, infinity; and cumulative probabilities P = 0.005, 0.01, 0.025, 0.05, 0.1, 0.25, 0.75, 0.9, 0.95, 0.975, 0.99, 0.995. Examples illustrating the use of the tables are given. Author (TAB)

N67-34104 Tata Inst. of Fundamental Research, Bombay (India).
LECTURES ON STRATIFICATION OF COMPLEX ANALYTIC SETS
M. H. Schwartz 1966 84 p refs

The principal material of this presentation is taken from a paper by H. Whitney concerned with tangents to an analytic variety (1965). Consideration is given to various decompositions of an analytic set into manifolds and to some of their applications. Stratifications of an analytic set having different properties are studied. Whitney's theorems a) and b) are proven using the main lines of his proofs, but for theorem b) the proof is rather different from Whitney's original one. As an application of theorem a), a result is established on a field of frames tangent to the strata of a stratification of an analytic set, along certain skeletons. R.N.A.

N67-34124# Stanford Univ., Calif. Operations Research House.
COMPLEMENTARY PIVOT THEORY OF MATHEMATICAL PROGRAMMING
Richard W. Cottle and George B. Dantzig Apr. 1967 39 p refs
(Contracts DAHC04-67-C-0028; N00014-67-A-0112-0011; AT(04-3)-326; Grant NSF GP-6431)
(TR-67-2; AD-653874) CFSTI: HC$3.00/MF$0.65

Problems of the form: Find w and z satisfying w = q + Mz, w = or > 0, z = or > 0, zw = 0 play a fundamental role in mathematical programming. This paper describes the role of such problems in linear programming, quadratic programming and bimatrix game theory and reviews the computational procedures of Lemke and Howson, Lemke, and Dantzig and Cottle. Author (TAB)

N67-34131# Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Angewandte Mathematik.

REPORTS ON THE METHODS OF THE STEEPEST DESCENTS IN THE LINEAR OPERATOR THEORY [BEITRAEGE ZUR METHODEDES STEILSTEN ABSTIEGES IN DER THEORIE DER LINEAREN OPERATOREN]

Walter Petry Dec. 1966 32 p refs In GERMAN
(JUL-443-MA) CFSTI: HC $3.00/MF $0.65

The operator equation in a real Hilbert space is examined assuming continuation in each element of the space in direction of the negative gradient of the functional. Mathematically this leads to the solution of a differential equation resulting in a family of elements x(t) with $t \in (0, \infty)$. For the case of a limited linear operator T it is shown that the family x(t) always converges toward a solution x* of the operator equation provided a solution to the problem exists. In case the operator T can be expressed in the form T = I − A, a solution formulation of the operator equation will result which represents a generalization of a solution formulation for integral equations with a symmetrical core; in addition, an error estimate will result in that case. The method is also used to determine eigenvalue and characteristic element of a near self-adjoint, positively definite operator in a real Hilbert space, and it is shown that the steepest descent method always converges toward a characteristic element and the corresponding eigenvalue. Applications of the method in the theory of linear integral equations are demonstrated. Transl. by K.W.

N67-34190*# Rutgers Univ., New Brunswick, N. J. Statistics Center.

TABLES OF JOINT PROBABILITIES USEFUL IN EVALUATING MIXED ACCEPTANCE SAMPLING PLANS

E. G. Schilling and H. F. Dodge May 1967 57 p refs
(Contract Nonr-404(18))
(NASA-CR-87424; N-28) CFSTI: HC $3.00/MF $0.65 CSCL 12A

This report supplements Technical Reports No. N-26 [1] and No. N-27 [2] and provides tables for the evaluation of OC curves and associated measures of dependent mixed variables-attributes sampling plans for the case of single specification limit, and known standard deviation, assuming a normal distribution. The tables give values of $P_a(i,\bar{x}>A)$, the joint probability of a sample mean greater than some limit A and exactly i defectives in a sample, for sample sizes n = 4 to 10, values of i = 0, 1, 2, and fraction defective p = .005, .01, .02, .05, .10, .15, .20. These tables can be used in assessing the properties of various types of dependent mixed plans, by setting up the appropriate equations for such measures as the probability of acceptance (P_a), average sample number (ASN), average outgoing quality (AOQ), and average total inspection (ATI). Author

N67-34200# Stanford Univ., Calif. Dept. of Statistics.

RECONSTRUCTING PATTERNS FROM SAMPLE DATA

Paul Switzer 23 May 1967 36 p refs
(Contract Nonr-225(52))
(TR-126; AD-653877) CFSTI: HC $3.00/MF $0.65

A Euclidean region is partitioned in an unknown way into a known number of subregions. For a discrete set of points in the region we may observe into which subregion they each fall. The problem is to obtain an estimated reconstruction of the partition based on the observations. Section 1 outlines a probabilistic approach to the problem and defines criteria of goodness for an estimated reconstruction. Section 2 evaluates the performance of nearest-point rules. Section 3 examines the effect of sample-size and compares several arrangements of the data points. Section 4 proposes a modification of nearest-point procedures having a certain optimality property. Section 5 is more or less independent of the earlier sections; it explores several probabilistic partitioning models. Author (TAB)

N67-34241# Washington Univ., Seattle.

WEAKLY ALMOST PERIODIC FUNCTIONS ON DISCRETE GROUPS

Donald E. Ramirez Jun. 1967 5 p refs
(Contract N00014-66-C-0269)
(AD-653894) CFSTI: HC $3.00/MF $0.65

Let gamma be an infinite discrete Abelian group. The author shows that the Fourier–Stieltjes transforms on gamma are not uniformly dense in the weakly almost periodic functions on gamma. Author (TAB)

N67-34244# Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Angewandte Mathematik.

ON A GENERALIZATION OF THE ABEL INTEGRAL EQUATION [UEBER EINE VERALLGEMEINERUNG DER ABELSCHEN INTEGRALGLEICHUNG]

Helmut Neunzert and Joachim Wick Dec. 1966 27 p refs In GERMAN
(JUL-442-MA) CFSTI: HC $3.00/MF $0.65

Treated is a generalization of the Abel integral equation which can be written in the form $\Gamma(1/2)\, f(x) = I^{1/2} g(x)$ when using a definition of the integration with discontinued order. The method is then applied to solve the equation $\int_0^x K(x-t)\, H(t)\, dt = 1$. For obtaining the existence statement, the method does not surpass the results obtainable with the Laplace transformation, but it circumvents the problem of the existence of a prototype function and yields simpler equations. A polynomial case and the approximation statement are demonstrated, and the results are discussed based on examples. Transl. by K.W.

N67-34275# Brown Univ., Providence, R. I. Div. of Applied Mathematics

OPTIMAL QUADRATURES IN $L^2(E_p)$, II

Robert E. Barnhill Mar. 1967 18 p refs
(Contract Nonr-562(36); Grant NSF GP-5908)
(AD-653713) CFSTI: HC $3.00/MF $0.65

This paper is an extension of an earlier paper in which the hypercircle inequality was applied to quadratures of a certain class of analytic functions. In this paper the quadratures nodes are allowed to be variable and the bound obtained from the hypercircle inequality is minimized with respect to the nodes. Computed tables and examples are also given. Author (TAB)

N67-34302# Institute for Defense Analyses, Arlington, Va. Research and Engineering Support Div.

THE GENERAL SPACE-MOMENTUM COMMUTATION RELATION

David M. Rosenbaum Jun. 1967 24 p refs
(Contract DAHC15-67-C-0011)
(P-326; AD-653836) CFSTI: HC $3.00/MF $0.65

The paper derives the general commutator (q to the mth power, p to the nth power) for all integer m and n, positive or negative. Two new identities for the binomial coefficients are derived using the general commutator. A simple example of the use of the general commutation relations is given in the expansion of (AP + BQ) to the nth power (A, B, constants) in normal form for integer n. Author (TAB)

N67-34306# California Univ., Berkeley. Operations Research Center.

ON THE TOURS OF A TRAVELING SALESMAN

Katta G. Murty Feb. 1967 23 p refs
(Grant NSF GP-4593)
(ORC-67-11) CFSTI: HC $3.00/MF $0.65

It has been proved that the traveling salesman problem is a special case of the general problem of finding the minimal cost adjacent vertex of a given vertex in a linear programming problem. The convex hull of the set of all the tours is characterized.

A rule is given by which it can be tested whether any two given tours are adjacent vertices on this convex hull or not. Based on this rule an algorithm has been described for generating all the adjacent tours of a given tour. This algorithm can be used for solving the traveling salesman problem. The solution method will be discussed in another paper. Author

N67-34373*# Stanford Univ., Calif. Dept. of Statistics.
OPTIMAL ALLOCATION IN A PURE CAPITAL MODEL WITH WITHDRAWALS: ASYMPTOTIC PROPERTIES AND ALGORITHMS
Alan J. Seelenfreund 31 May 1967 83 p refs Sponsored in part by NASA
(Contracts Nonr-225(53); Nonr-225(50))
(NASA-CR-87431; TR-95) CFSTI: HC $3.00/MF $0.65 CSCL 05C

A mathematical formulation and analysis of a class of economic processes showing asymptotic properties and algorithms are presented. The economic processes considered have a particular common structure that can be exploited to facilitate computation of optimal policies, and to obtain insight into the behavior of the process after it has been in operation for a period of time. The specific models analyzed relate to capital budgeting, price speculation, warehouse operation, and economic growth. R.Li.

N67-34464 Tata Inst. of Fundamental Research, Bombay (India).
LECTURES ON GEODESICS IN RIEMANNIAN GEOMETRY
M. Berger 1965 328 p refs

The foundations of riemannian geometry are treated through the tangent bundle and the geodesic flow on it. Global results for riemannian manifolds subject to geometric conditions of various types are given. The geodesics in an S.C. manifold and Zoll's surface (a riemannian manifold) are described. The Hopf–Rinow theorem, a closed geodesic in a nonzero free Homotopy class of a compact riemannian manifold, and the isometry between two simply connected and complete riemannian manifolds of the same constant sectional curvature are discussed. The theorems of Myers and Synge, the Gauss–Bonnet formula, and a result on complete riemannian manifolds of nonpositive curvature are presented. The theorems of Loewner and Pu, which are isoperimetric inequalities on the two-dimensional torus and the two-dimensional real projective space, are included but these results involve no geodesics. R.N.A.

N67-34878# Los Alamos Scientific Lab., N. Mex.
BIORTHOGONAL ANGULAR POLYNOMIAL EXPANSIONS OF THE TWO DIMENSIONAL TRANSPORT EQUATION
K. D. Lathrop and N. S. de Muth [1966] 4 p refs Presented at the 13th Ann. Meeting of the Am. Nucl. Soc., San Diego, Calif.
(Contract W-7405-ENG-36)
(LA-DC-8478; CONF-670602-2) CFSTI: HC $3.00/MF $0.65

In forming approximations to the Boltzmann transport equation, a common approach involves the expansion of angular dependence of the directional flux in spherical harmonic functions. A method is described in which the directional flux is expanded in either of two systems of polynomials in two variables. NSA

N67-34789# Oak Ridge National Lab., Tenn.
REMARKS ON ESTIMATION PROBLEMS FOR THE PARAMETERS OF THE NEYMAN-TYPE A DISTRIBUTION
K. O. Bowman and L. R. Shenton May 1967 62 p refs
(ORNL-4102) CFSTI: HC $3.00/MF $0.65

The Neyman Type A distribution defined on the non-negative integers depends on two parameters θ_1, θ_2, and is structurally the simplest of the Neyman contagious distributions. These have wide application in biology, ecology and other branches of natural science. At the present time very little is known about the distributional properties of the estimators of the parameters involved, and large sample theory is invoked with naive uncriticality. The study which is confined to the Type A distribution shows that moment estimators only have moments in a conditional sense, and that in their expansions higher order asymptotics may dominate the traditional lower order terms, in particular in two regions of the parameter space. The first region is that part of the parameter space in which the index of dispersion or contagion θ_2 is small; here the distribution becomes tangential to the Poisson distribution. The second region is that part of the parameter space contained by a parabolic arc sweeping away from the origin with an axis inclination of about 45°; within this region the distribution has high modality, the modes being spaced at intervals of θ_2 approximately. In both these regions samples of more than 500 may be required to give the appearance of stability to the moment expansions of moment statistics and maximum likelihood statistics. As a rough assessment the estimators of θ_1 (the index parameter) require larger samples for stabilization than those for θ_2. Again the sample size is about the same for moment and maximum likelihood estimators. Moreover, in general, a larger sample is needed for a higher moment than for a lower moment. Critical remarks are also offered on the meaning of asymptotic efficiency and its misleading undertones. Author (NSA)

N67-34807*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THERMAL BENDING PLUS TWIST OF A THIN-WALLED CYLINDER OF OPEN SECTION WITH APPLICATION TO GRAVITY GRADIENT BOOMS
Harold P. Frisch Washington, NASA, Aug. 1967 64 p refs
(NASA-TN-D-4069) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A detailed analysis of the six-dimensional shapes of a particular type of gravity gradient boom bent and twisted by the thermal stresses induced by a solar thermal field is presented. Contained within the analysis is a general method of solution, particularly suited for the deflection analysis of very long thin-walled members of open section having a forcing function that varies along the length and depends on the position and orientation of the cross section relative to a fixed reference frame. The results given are intended to illustrate the effects of transverse-torsional coupling on the static-thermal-equilibrium shapes of the boom. It is shown that, for the gravity gradient boom studied, the thermal equilibrium shape is not unique and that it is not apparent which of the possible shapes are stable. It is thus evident that a planar assumption for thermal bending of any similar gravity gradient boom must be strongly justified before it can be assumed credible. Author

N67-34881*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
APPROXIMATE SOLUTIONS OF RUNGE–KUTTA EQUATIONS
Joseph S. Rosen Washington, NASA, Aug. 1967 33 p refs
(NASA-TN-D-4082) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The determination of the parameters which enter the higher-order Runge–Kutta processes used for the numerical solution of differential equations is presented. As the order of the process increases, the number and the complexity of the system of equations which determine the parameters in the Runge–Kutta formulation increases; also, the number of the evaluations of the function which is being integrated increases rapidly with the order. Since the latter is frequently the most time consuming computational aspect of the integration problem, approximate Runge–Kutta formulations which reduce the number of these evaluations without impairing the efficiency of the process are acceptable. Some of the techniques for obtaining these parameters—and the nature of the approximations engendered—are examined here for particular orders as these involve general aspects which persist and are as pertinent in the higher-order approximations. Author

N67-34905# College of Aeronautics, Cranfield (England).
A NEW CLASS OF SUBHARMONIC SOLUTIONS TO DUFFING'S EQUATIONS
P. A. T. Christopher Mar. 1967 55 p refs
(COA-AERO-195) CFSTI: HC $3.00/MF $0.65

The existence of exact, pure-subharmonic, solutions of a fairly general type of ordinary, nonlinear, differential equation of second-order was established previously. A particular, degenerate, form of that equation is Duffing's equation, without damping, i.e., the term in x is absent. The present study is concerned with this equation and it is shown that there is associated with the pure-subharmonic solution a class of exact subharmonic solutions which may be represented by a Fourier series whose maximum period is that of the subharmonic. Author

N67-34932# Institute for Perception RVO–TNO, Soesterberg (Netherlands).
THE CONSTRUCTION OF DIGRAM-BALANCED LATIN SQUARES
W. A. Wagenaar 1967 9 p ref
(TDCK-48386; IZF-1967-11) CFSTI: HC $3.00/MF $0.65

Some simple methods to construct digram-balanced latin squares for all even values of n are presented. These squares are defined as those in which each numeral is given and followed by each other numeral just once. Author

N67-34956# Rocketdyne, Canoga Park, Calif.
RESULTS ON LOCATION AND SCALE PARAMETER ESTIMATION WITH APPLICATION TO THE EXTREME-VALUE DISTRIBUTION
Nancy R. Mann Wright-Patterson AFB, Ohio, ARL, Feb. 1967 187 p refs
(Contract AF 33(615)-2818)
(ARL-67-0023; AD-653575) CFSTI: HC $3.00/MF $0.65

The report gives results concerning estimation of location and scale parameters. Most of the work pertains to the first extreme-value distribution of smallest values, the distribution of the natural logarithms of failure times having the two-parameter Weibull distribution. Experimental designs are derived, under the assumption that log failure times are polynomial functions of the reciprocal of stress level and have the extreme-value distribution, for over-stress life tests. These designs yield least-squares curves with minimum variance at a specified (nominal) stress level below the levels at which the life test is conducted. An estimate of the extreme-value location parameter u associated with the nominal stress level and the relationship between u and stress level can be obtained from the least squares curve. Other extreme-value results apply to a life test conducted at a single fixed stress level. Author (TAB)

N67-34975# Stanford Univ., Calif. Inst. for Mathematical Studies in the Social Sciences.
APPLICATIONS OF CONTROL THEORY TO ECONOMIC GROWTH
Kenneth J. Arrow 14 Jul. 1967 54 p refs Presented at the Am. Mathematical Soc. Summer Seminar on the Math. of the Decision Sci., Stanford, Calif., 10 Jul.–11 Aug. 1967
(Grant NSF GS-1440)
(TR-2)

Basic theorems of optimal control theory are reviewed, with emphasis focused on the special features appropriate to their use in growth theory, such as the assumption of an infinite horizon, and the presence of constraints on the choice of control variables. Criteria for optimizing dynamic processes in continuous times are defined. A simple capital accumulation one-commodity model is examined in detail. The commodity can be either consumer or invested, and is considered from the viewpoint of a government which is in a position to control the economy completely and to plan perfectly so as to optimize the investment and consumption aspects of the economic system. The concept of irreversible investment is discussed in relation to population growth, an expanding labor force, and technological changes, and a model is developed. A modified version of this model is applied to optimal growth in underdeveloped countries where it is hypothesized that an advanced and a backward economic system exists side-by-side. For simplicity, it is assumed that the population and available labor force are constant, and that there is no technological progress. M.G.J.

N67-35012*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A CRITICAL ANALYSIS OF VARIOUS NUMERICAL INTEGRATION METHODS FOR COMPUTING THE FLOW OF A GAS IN CHEMICAL NONEQUILIBRIUM
Harvard Lomax and Harry E. Bailey Washington, NASA, Aug. 1967 44 p refs
(NASA-TN-D-4109) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The efficiency and accuracy of several different techniques proposed for the numerical integration of ordinary differential equations with widely varying damping properties are examined. The methods analyzed include the standard Runge–Kutta method, a modified Runge–Kutta method proposed by Treanor, predictor–corrector schemes, and implicit procedures. First, the methods are studied as they apply to linear coupled differential equations with constant coefficients. The conclusions drawn from these studies are then tested in nonlinear cases by numerical calculations made for a gas in chemical nonequilibrium behind a normal shock wave. An implicit method is strongly recommended if the local eigenvalues are negative (damping) and widely separated. Author

N67-35209# General Electric Co., Schenectady, N. Y. Research and Development Center.
REFERENCE NOTES ON BASIC STATISTICS AND PROBABILITY
G. J. Hahn Feb. 1967 129 p refs
(Rept.-67-C-040)

The purpose of these notes was to supplement course lectures and to include material on both theory and applications which could not be covered in the available class time. The greater part is devoted to a discussion of the properties, development, inter-relationship and use of statistical distributions. Other subjects discussed briefly include elementary probability, Bayes' theorem, basic definitions concerning univariate and multivariate distributions, averages and variances of functions of random variables, and the laws of quantum statistics. A review of the literature of statistics is also included. Author

N67-35291 Joint Publications Research Service, Washington, D. C.
SERVICING OF TWO FLOWS WITH A RELATIVE PRIORITY IN A FULLY ACCESSIBLE SYSTEM WITH A RESTRICTED NUMBER OF PLACES FOR WAITING
G. P. Basharin *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 105–125 refs (See N67-35281 20-10)

A fully accessible c-line queueing system is analyzed to which two simplest flows of demands come with a relative priority. The servicing time for the demands of each flow has an exponential distribution with the same average value. The case of a common queue and the case of separate queues are investigated. Author

N67-35292 Joint Publications Research Service, Washington, D. C.
OPTIMAL ABSOLUTE DYNAMIC PRIORITIES IN QUEUEING SYSTEMS
Ye. B. Veklerov *In its* Tech. Cybernetics, No. 2, 1967 11 Jul. 1967 p 126–132 refs (See N67-35281 20-10)

In previous studies the problem of optimal selection of priorities was solved for a number of one line queueing systems

and the concept of dynamic priorities was introduced. It was indicated that, in the case of servicing without a discontinuity, the optimal policy in the class of dynamic priorities belongs to a narrower class of ordinary priorities. In this study similar results are obtained for the case of servicing with a discontinuity. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N67-34223# McGill Univ., Montreal (Quebec). Stormy Weather Group.
STUDIES OF THE FORMATION OF PRECIPITATION IN CONVECTION
R. C. Srivastava and Marianne English Apr. 1967 60 p refs
(Contract F19628-67-C-0129)
(MW-47; SR-1; AFCRL-67-0199; AD-653610) CFSTI: HC $3.00/MF $0.65

The effect of precipitation on the properties of a one-dimensional non-entraining cumulus is studied by numerically integrating the equation of motion and the equation of conservation of water substance. The initial state is taken to be the steady-state solution of the equations in the absence of precipitation. Two models of precipitation development are considered. In the first model, the cloud water is considered to change into rainwater at a prescribed rate, whenever the cloud water content exceeds a given critical value. The raindrops are assumed to have an exponential size distribution and to grow by coalescing with the cloud drops. In the second model, all the cloud water is considered to change, at a given instant, into raindrops of a given fall speed. The main conclusions are: (1) a downdraft develops in the lower levels, (ii) the cloud grows vertically consequent upon the development of precipitation, and (iii) the updraft and water content execute coupled oscillations. English: Results obtained with a new program for the calculation of hail growth are compared with earlier calculations. It is concluded that growth of hail is actually faster than indicated by the earlier results, but the computed hailstones still contain about 80% liquid. The growth equations are fully derived. Author (TAB)

N67-34307 Stanford Research Inst., Menlo Park, Calif.
CLOUD PHOTO-INTERPETATIONS FOR WEST COAST WEATHER Final Report
J. H. S. Kealoha Dec. 1966 45 p refs
(Contract Cwb-11091)

Ten weather situations off the west coast of the United States are used to demonstrate the potential that photo-interpretation of satellite pictures has for the meteorologist. Particular attention is directed toward increasing his awareness of their operational possibilities for forecasting in specific areas such as agriculture and aviation. Supporting data consisted of synoptic analyses, radar, and teletype hourly sequences. Author

N67-34345 Royal Aircraft Establishment, Farnborough (England).
THE PREDICTION OF NOCTURNAL TEMPERATURE MINIMA BY MEANS OF A BALANCING CALCULATION [DIE VORHERSAGE DES NACHTLICHEN TEMPERATUR-MINIMUMS MIT HILFE DER AUSGLEICHSRECHNUNG]
W. Mueldner May 1967 21 p refs Transl. into ENGLISH from Meteorol. Rundschau (W. Germany), v. 14, no. 6, 1961 p 170–175
(RAE-LIB-TRANS-1226)

From observation material gathered over three years (199 cases), formulas have been developed for the determination of the temperature minimum, from the temperature and dew point of the previous day, on cloud-free nights with a light wind, by means of a balancing calculation. In special cases the effect of a layer of snow (24 cases) and of very dry ground (37 cases) have been investigated. Finally the influence of cloudiness as regards cloud base and cloud amount was investigated. The formulas obtained were tested on 63 cases. Author

N67-34415# California Univ., Livermore. Lawrence Radiation Lab.
DEVELOPMENT OF AN AIRBORNE EHF RADAR SYSTEM FOR CLOUD DETECTION
P. V. Colmar and R. T. Williams Feb. 1967 32 p refs
(Contract W-7405-ENG-48)
(UCRL-50195) CFSTI: HC $3.00/MF $0.65

The LAPQ-1 airborne radar system was developed to detect and delineate nuclear clouds so that an aircraft could be directed into the proper position to launch ballistic sampling rockets into the clouds. The radar beam has a width of less than one degree, a wave length of less than one centimeter, and a frequency of 35 giga-Hertz. The average power is only 40 W, while the peak power is 100 kw delivered in 400 one-microsecond pulses per second. The system provides both vertical and horizontal views through target clouds, and can scan 180 degrees horizontally or 60 degrees vertically at a rate of six times a minute. Ice clouds similar to nuclear clouds were detected at ranges up to 198 nautical miles, and the rear edges of clouds up to 50 miles across were delineated. Cloud targets were acquired at a range of 25 miles after penetration of 10 miles of heavy rainfall. Operation in the extremely high-frequency (Ka) band makes the system most suitable for studies of cloud physics phenomena, or for other applications in which superior resolution, small antenna apertures, and reduced weight are important considerations. Signal attenuation was substantially less than expected, particularly in heavy rainfall at low altitudes, which suggests that existing attenuation data for the Ka band should be re-examined. Author (NSA)

N67-34516# Stanford Research Inst., Menlo Park, Calif.
LIDAR OBSERVATIONS AT NORMAN, OKLAHOMA Summary Report, 18–23 Jan. 1966
Ronald T. H. Collis Feb. 1966 21 p ref
(Contract Cwb-11244)

Experimental lidar observations recorded at the National Severe Storms Laboratory are summarized. Initial lidar observations of falling snow and of cloud and fog conditions associated with snowfall were obtained. A series of observations were also made in very cold, clear air, and quantitative data were obtained on the changes that took place in the stratification in the airflow. Meteorological data were compared with the lidar data and a preliminary comparison was made between the lidar data and radar data, which were recorded concurrently. Simple graphical plotting and digital and analog computer techniques were used in analyzing the observational data. Preliminary findings indicate that lidar has the capability of observing and evaluating parameters of the lower atmosphere such as: the coefficient of extinction and its changes; the depth of the low level haze layer and other discontinuities in the aerosol density that may be connected with stratification; and the cloud base. Characteristics of the lidar equipment used in the experimental program are given. EC

N67-34535 Ministry of Technology, London (England).
PROJECT TOPCAT: POWER SPECTRAL MEASUREMENTS OF CLEAR AIR TURBULENCE ASSOCIATED WITH JET STREAMS
C. K. Rider (Aeron. Res. Labs., Melbourne) and Anne Burn HMSO, 1967 39 p refs Supersedes RAE-TR-65210; ARC-27611
(ARC-CP-940; RAE-TR-65210; ARC-27611) HMSO: 7s 6d

Preliminary information on the power spectral data obtained during Project TOPCAT in Australia is presented. Measurements of moderately severe clear air turbulence were obtained from a Canberra aircraft flying at altitudes of 26,000 to 33,000 ft in the vicinity of the sub-tropical jet stream. In some respects, particularly at long wavelengths, the spectra are dissimilar to those found for low level turbulence and there are indications that the turbulence is anisotropic. At short wavelengths the power spectra agree well with a -5/3rd power law, and the energy densities of the three components (u_g, v_g, w_g) are similar. Author

N67-34736 Royal Radar Establishment, Malvern (England).
DOPPLER RADAR MEASUREMENTS ON A SEVERE LOCAL THUNDERSTORM IN SWITZERLAND
H. W. Bahns and A. J. Whyman Oct. 1966 37 p refs
(RRE-TN-713)

A description is given of a mobile radar to measure the vertical velocities of precipitation particles in thunderstorms. From such measurements the velocities of up and down draughts can be determined. Observations on thunderstorms were made at the Swiss observatory at Locarno–Monti in August 1963. One storm has been analyzed, showing up and down draughts in excess of 10 msec.$^{-1}$. An Appendix describes desirable modifications to the equipment and a method of analysis, which would be of benefit in future observations. Author

N67-34841# RAND Corp., Santa Monica, Calif.
PROCEEDINGS OF THE SYMPOSIUM ON THE ARCTIC HEAT BUDGET AND ATMOSPHERIC CIRCULATION
J. O. Fletcher, ed. Dec. 1966 562 p refs Symp. held at Lake Arrowhead, Calif., 31 Jan.–4 Feb. 1966; Sponsored by California Univ. and RAND Corp.
(Grant NSF C-415)
(RM-5233-NSF)

Conference proceedings are presented on the interaction of climate and the Arctic heat budget, quantitative evaluations of the Arctic heat budget, models of atmospheric circulation and oceanic circulation, and ocean–atmosphere interactions. For individual titles, see N67-34841 through N67-34864.

N67-34842# Main Geophysical Observatory, Leningrad (USSR).
POLAR ICE AND CLIMATE
M. I. Budyko *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 3–21 refs (See N67-34841 20-20)

Two questions are considered: the influence of climate on ice cover, and the influence of ice cover on climate. The most important factors influencing the melting of ice are the total radiation and the air temperature, whereas the rate of freezing depends on air temperature and ice thickness. Systematic calculations show that small positive air temperature anomalies in summer would cause the Arctic pack ice to disappear in a few years, after which the Arctic Ocean would remain ice-free, resulting in important changes in climatic conditions for the Northern Hemisphere. In turn, an ice cover could be re-established on an ice-free Arctic Ocean by anomalies of air temperature arising from various causes. Thus the present Arctic ice cover is in rather delicate balance with the prevailing climate-forming factors, and could possibly be destroyed by artificial means. However, it is not at all clear that such a change would be beneficial. Author

N67-34843# RAND Corp., Santa Monica, Calif.
THE ARCTIC HEAT BUDGET AND ATMOSPHERIC CIRCULATION
J. O. Fletcher *In its* Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 23–43 refs (See N67-34841 20-20)

An assessment is made of each component of the heat budgets of the surface and of the earth–atmosphere system in the central Arctic, both for an ice-covered ocean and for an ice-free ocean. The annual patterns of atmospheric heat loss for both conditions are obtained as residuals; the relation of these patterns to general atmospheric circulation is discussed. An ice-free Arctic Ocean would probably be associated with atmospheric circulation more vigorous in summer at subarctic latitudes and of comparable vigor in winter. The cool summers and warm, moist winters would be highly conducive to glacier growth. Author

N67-34844# Environmental Science Services Administration, Washington, D. C.
STOCHASTIC MODELS OF AIR–SEA INTERACTION AND CLIMATIC FLUCTUATION
J. M. Mitchell, Jr. *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 45–74 refs (See N67-34841 20-20)

Following a brief review of the central problem of climatic change and its causes, with special reference to the climatic fluctuation of the past century, the potentially important role of air–sea interactions in stimulating climatic fluctuation is explored in some depth from a special statistical viewpoint. Two stochastic models of air–sea interaction are proposed, in each of which the time history of net heat exchange between an idealized ocean and the atmosphere is regarded as the fundamental climate governing variable. In the first model, the heat exchange is prescribed by a Markov process that is found to be compatible with the serial correlation function of observed monthly-mean sea-surface temperature anomalies. In the second model, the heat exchange is specified by statistical fluctuations in the principal terms of the heat budget at the ocean surface. Under conditions that are felt to be quite generally valid, these fluctuations result in a cumulative heat storage in the ocean that leads to very long-term anomalies of temperature of the ocean–atmosphere system. The first model is believed to yield a conservative estimate of the magnitude of climatic fluctuation due to thermal air–sea interaction, and the second model, a liberal estimate that must become unrealistic after extended periods of geological time. Author

N67-34845# Arctic and Antarctic Scientific Research Inst. (USSR).
HEAT REGIME OF THE SOVIET ARCTIC RELATED TO THE MAIN ATMOSPHERIC CIRCULATION PATTERNS AND THEIR MANY YEARLY VARIATIONS
A. A. Girs *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 75–111 refs (See N67-34841 20-20)

As the various components of the Arctic heat budget are influenced by the character of the large-scale circulation of the atmosphere, it is therefore possible to infer certain changes in the Arctic heat regime from observed changes in atmospheric circulation. The general circulation processes for the Northern Hemisphere are classified into nine types, and for each type of corresponding anomalies of temperature, pressure, cloudiness and other parameters are considered. What is known about the long-term changes in the Arctic heat regime agrees well with inferences drawn from consideration of the observed long-term trends in the frequency of occurrence of various types of circulation. Author

N67-34846# Arctic and Antarctic Scientific Research Inst. (USSR).
A QUANTITATIVE DESCRIPTION OF SOME CHARACTERISTICS OF THE GENERAL ATMOSPHERIC CIRCULATION AND THEIR RELATION TO THE RADIATION REGIME OF THE ARCTIC
Ye. P. Borisenkov *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 111–135 refs (See N67-34841 20-20)

Using energy principles, a model atmosphere energetically invariant to the real atmosphere is constructed. The available potential energy was considered to be one of the numerical characteristics of the general atmospheric circulation, this being a function of temperature and pressure at sea level, as well as of the polytropic properties of the atmosphere. To calculate this index, the characteristics of the mean energy level are used. A statistical analysis of the pressure fields, geopotential fields, fields of temperature, and total radiation is performed on the basis of mean monthly values for a 10-year period, and expanded into proper orthogonal functions. A physical interpretation of the first terms of the expansion is given, and the regularities of the general atmospheric circulation in the Arctic are analyzed on the basis of the numerical characteristics obtained. Author

N67-34847# Axel Heiberg Expedition, Montreal (Quebec).
EVIDENCE OF CLIMATIC FLUCTUATIONS ON AXEL HEIBERG ISLAND, CANADIAN ARCTIC ARCHIPELAGO
F. Mueller *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 135–157 refs (See N67-34841 20-20)

For the last six years (1959–1965), the annual mass budget of three valley glaciers and a large ice cap has been calculated in varying degrees of detail. Three weather stations were operated. Since 1948, meteorological data have been accumulating from the nearby government weather stations at Eureka and Isachsen. A study of these sources showed unexpectedly wide variations in the climatic conditions from year to year. The marked recession of the margins of all small glaciers, and to a lesser degree, of most medium-sized ones, as well as the stratigraphic analysis of a deep firn profile on the ice cap, indicate a change to conditions less favorable for glaciers starting about 1930. The strong advance of the tongues of most of the large glaciers is the delayed reaction to an increase in ice mass occurring 50 to 100 years ago. It is concluded that glacier fluctuations have been surprisingly small during the last 9000 years, and possibly during the last 20,000 years, despite the large annual variations in the heat and mass budgets. Author

N67-34848# Environmental Science Services Administration, Silver Spring, Md.
THE INFLUENCE OF GREENLAND ON THE GENERAL ATMOSPHERIC CIRCULATION
P. Putnins *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 157–177 refs (See N67-34841 20-20)

The meridional exchange of air masses over the Greenland ice cap is pronounced. Interdiurnal temperature changes as large as 30°C and changes of tropopause height of 6000 m in 24 hours have been observed. An examination of upper wind data for approximately 10 years showed that, at some stations, the meridional components are dominant. The influence of the Greenland massif on the general atmospheric circulation can also be demonstrated by the annual course of the zonal index west and east of Greeland. In the zone east of southern Greenland the annual variation is dominant, but in the zone west of Greeland the semi-annual variation is dominant; in the zone south of Greeland, however, the annual variation is dominant in both the eastern and western parts. The relatively frequent cyclogenesis northwest of Greenland can be partly explained, in some cases, not only by the surface advection of warm air from the south, but also by the relatively strong (west–east) isobaric temperature gradient aloft. Temperature lapse rates and the frequency of adiabatic and superadiabatic cases are greater over the northwestern than over the southwestern coast. Author

N67-34852# Arctic and Antarctic Scientific Research Inst. (USSR).
CHARACTERISTICS OF THE HEAT EXCHANGE
Yu. P. Doronin *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 247–266 refs (See N67-34841 20-20)

An analysis of heat-balance components of the active sea layer in the Arctic is presented, with emphasis on the computation of balance components on the basis of standard observational data. The effects of density stratification of the water-surface layer on both the degree of water mixing and the roughness parameter of surface water are given. Heat exchange through the ice and the role of inner heat sources caused by the phase transformations of the brine are discussed. Estimated values of some heat flows in the Arctic are given. Author

N67-34853# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
HEAT BUDGET AT THE SURFACE OF THE ARCTIC OCEAN
F. I. Badgley *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 267–277 refs *Its* Contrib. 121 (See N67-34841 20-20)

The heat budget of the surface of the central Arctic Ocean deduced from American and Russian data is shown by months. Separate budgets are given for mature ice floes and for narrow open leads. Radiative fluxes are important at all times; turbulent flux of enthalpy is important, even dominant, from open leads in winter. Indirect evidence indicates there must be less than 1 percent open water in the central Arctic in winter. Author

N67-34854# Arctic and Antarctic Scientific Research Inst. (USSR).
NUMERICAL CHARACTERISTICS OF THE RADIATION REGIME IN THE SOVIET ARCTIC
M. S. Marshunova and N. T. Chernigovskiy *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 279–297 refs (See N67-34841 20-20)

An estimate is made of the main regularities in the spatial and temporal distribution of the radiation balance components of the Soviet Arctic; that is, total and absorbed radiation, effective radiation, and radiation balance of the underlying surface. Radiation properties of the underlying land and sea surface are discussed, including annual albedo variations, effects of meltwater pools on the absorbed radiation, and radiation penetration into the snow and ice. A comparison is made of radiation flow data in the ocean under the pack ice, in the clearings in the ice, and in open water. Instruments employed in the Soviet radiation studies are briefly described. Monthly amounts of the main components of the radiation balance are shown in tables. Author

N67-34855# McGill Univ., Montreal (Quebec). Dept. of Meteorology.
POSSIBLE CHANGES IN THE RADIATION BUDGET OVER THE POLAR OCEAN
E. Vowinckel and S. Orvig *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 299–303 (See N67-34841 20-20)

An analysis of possible changes in the radiative terms of the polar ocean energy budget is presented. Clouds and surface albedo were examined, and the absorbed solar radiation was calculated for various extreme surface and atmospheric conditions. There is greater possibility of variations in longwave radiation than in solar radiation. Theoretical polar atmospheres were investigated, and it is concluded that the atmosphere is at present adjusted in the best possible way for the conservation of energy. Longwave fluxes were calculated for the condition of an open polar ocean in winter and for a polar ocean completely frozen throughout the year. Various radiation budgets are presented for different assumed

conditions. The optimum surface conditions would occur with winter overcast and summer clear sky. The earth–atmosphere radiation budget is presented for an open polar ocean with cloud conditions such as presently found over the Norwegian Sea. Author

N67-34860# Main Geophysical Observatory, Leningrad (USSR).
THE INFLUENCE OF THE ARCTIC ICE COVER ON THE ZONAL DISTRIBUTION OF ATMOSPHERIC TEMPERATURE
L. R. Rakipova *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 411–441 refs (See N67-34841 20-20)

A theory of temperature zonal distribution is set forth, in which the major factors determining the heat regime of the atmosphere are considered. The changes in the thermal and circulation regimes of the atmosphere that take place as a result of melting of the Arctic ice cover are estimated. Author

N67-34861# Air Force Cambridge Research Labs., Bedford, Mass.
AN INVESTIGATION OF THE EFFECTS OF HIGH-LEVEL HEATING ON THE LARGE-SCALE CIRCULATION OF THE LOWER ATMOSPHERE
L. Berkofsky and R. Shapiro *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 443–467 refs (See N67-34841 20-20)

Numerical integrations are carried out from actual data, starting with two different initial situations accompanying moderate geomagnetic disturbances. The differences between the calculations with and without high-level heating are discussed and compared, as are the results from experiments in which the auroral heating region is latitudinally compressed. Author

N67-34862# California Univ., Los Angeles. Dept. of Meteorology.
ATMOSPHERIC TELECONNECTIONS RESPONDING TO EQUATORIAL ANOMALIES OF OCEAN TEMPERATURE
J. Bjerknes *In* RAND Corp. Proc. of the Symp. on the Arctic Heat Budget and Atmospheric Circulation Dec. 1966 p 473–497 refs (See N67-34841 20-20)

Consideration is given to the possible influence upon the Arctic climate of low-latitude anomalies in atmospheric and oceanic circulation. Attention is focused upon the anomaly known as El Nino conditions. The chain of events starts with an abnormal decrease of the equatorial easterlies toward Christmas time (the Southern Hemisphere midsummer). A weakening of the upwelling of cold water at the equator follows immediately. While the Southern Hemisphere summer produces the anomalous warmth of equatorial waters, the Northern Hemisphere's wintertime tradewind circulation is exposed to a higher-than-normal low-latitude heat supply. An acceleration of the Hadley circulation follows, increasing in turn the flux of angular momentum to the westerlies. The maps show that the earth quadrant affected by El Nino warming at the equator develops strong westerlies over the northeastern Pacific and a deep low in the Gulf of Alaska. Moreover, by the way of atmospheric teleconnections, the Iceland Low and the Atlantic westerlies become quite weak. Author

N67-35133 Meteorological Office (Gt. Brit.)
SURFACE AND 900 MB WIND RELATIONSHIPS
J. Findlater, T. N. S. Harrower, G. A. Howkins, and H. L. Wright London, HMSO, 1966 44 p refs *Its* Scientific Paper No. 23 (MET-O-773) HMSO: 5s 6d

Winds at the surface and 900 mb for two ocean weather stations were compared objectively. Similar comparisons were made of the surface winds at Leuchars and London (Heathrow) Airport with 900 mb winds at the nearby radiosonde stations Shanwell and Crawley respectively. A basis was obtained for forecasting the surface wind from the geostrophic wind for sea areas but not for land areas. However, the data are of interest in relation to general questions of turbulence and are presented in some detail. Author

N67-35160# Joint Publications Research Service, Washington, D. C.
CLIMATE OF CHINA
Ping-Hai Chu 14 Jun. 1967 631 p refs Transl. into ENGLISH of the book "Chung-Kuo Ch'i-Hou" Peking, Sci. Publishing House, Sep. 1962 p 1–363
(JPRS-41374; TT-67-32008) CFSTI: HC $3.00/MF $0.65

A general treatise on the climate of China includes: (1) an analysis of the characteristics of the principal factors affecting the climate; (2) a substantial description of the characteristics of, and the law of distribution for, the important factors of climate in China, such as temperature, precipitation, wind, humidity, cloudiness, fog, sunshine, evaporation and hydrological balance; and (3) classification of the climates in China into regions. The entire nation is divided into seven regions: the Northwest Region, the Mongolia–Sinkiang Region, the Yellow River Basin, the Yangtze Basin, the South China Region, the Yunnan Plateau–Transversal Mountain Region, and the Tibetan Plateau. A detailed analytical comparison is included on the climate characteristics and climate-forming systems of various regions. Author

N67-35252*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
AN ATLAS OF SPECTRA FROM 1.6 TO 5.4 MICRONS, AIRCRAFT MEASUREMENTS OVER NATURAL SURFACES AND ATMOSPHERES
W. A. Hovis and M. Tobin Aug. 1967 340 p refs
(NASA-TM-X-55882; X-622-67-358) CFSTI: HC $3.00/MF $0.65
CSCL 04B

An atlas of spectrometric data, digitally reduced from the data recorded by a spectrometer aboard a flight in a Convair 990 jet aircraft over a wide range of natural surface and atmospheric conditions, is presented. The spectra run from 1.6 to 5.4μ. A short, descriptive title is shown on each spectra as complete as available information allows. The spectra are presented in chronological order with the day and universal time noted on each. Energy is shown above and below a reference zero which corresponds to the reference black body in the instrument. Though the black body in the instrument was allowed to assume ambient temperature, all spectra were reduced so that the zero line corresponds to 273°K. L.S.

N67-35277 Comissao Nacional de Atividades Espaciais, Sao Jose Dos Campos (Brazil).
BRAZILLIAN PARTICIPATION ON EXAMETNET Status Report
J. A. M. Salgado, U. Belcolfine, M. Del Tedesco, and F. de Mendonca Sep. 1966 58 p Presented to the Executive Comm. Meeting, Ascochinga, Sep. 1966
(LAFE-47)

The 1966 and 1967 rocket launching schedules for the facility at Natal, Brazil, are presented. Rocket and Rawin data obtained between January 12 and August 17, 1966, are presented for 5 Hasp (Chaff), 3 Hasp (instrumented), and 8 Arcas (instrumented) launchings, representing 10 successes, one partial success, and two failures. A preliminary analysis is made of temperatures and winds; and mention is made of the personnel involved, ground instrumentation, and the data package exchange. M.W.R.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N67-34012# Franklin Inst., Philadelphia, Pa. Research Labs.
ANALYSIS OF CONTROL AND TRAFFIC IN OPERATIONAL NAS ENVIRONMENT Final Report
Natverbhai Amin and Clifton E. Mayfield May 1967 44 p refs
(Contract FA-65-WA-1155)
(RD-67-25)

The contract was intended to accomplish four tasks: determination of the applicability of the model to sector staffing, to the non-radar environment and to the terminal area environment, and simulation of control-load and airspace theory. Work completed was directed to the first and last of these tasks. This report summarizes the contractor's views of the model and related problems. It is based on thorough familiarity with the development and validation of the model. The model is examined in detail, improvements to it suggested, and directions pointed for its further development and evaluation; certain peripheral topics also are discussed. Author

N67-34285 Lockheed-Georgia Co., Marietta.
DEVELOPMENT OF ALL WEATHER LANDING SYSTEM RELIABILITY ANALYSIS AND CRITERIA FOR CATEGORY III AIRBORNE SYSTEMS. VOLUME II: APPENDICES
L. A. Adkins, J. D. St. Clair, M. C. Thatro, and H. R. Willis May 1967 105 p refs
(Contract FA-65WA-1376)
(ER-8957, Vol. II; SRDS-RD-67-20, Vol. II)

Supplementary data are presented in the form of appendices. Since a number of considerations associated with Category III landing problems presently defy quantification, an appendix was developed to investigate in general these considerations. The reliability analysis required a large and varied number of calculations. Appendices were developed to present examples of the manner in which these calculations were effected. Also presented is a discussion of a proposed two channel system exhibiting a fail operative capability, which is contrary to the fail passive characteristics of a two channel system assumed. A considerable amount of research was conducted to provide a basis for the development of a quantitative human error prediction procedure. The results of this research are presented in appendices covering general human factors considerations associated with Category III systems and an analysis of accident data which was conducted to investigate human error characteristics of aircraft accidents. Author

N67-34568# Lockheed-Georgia Co., Marietta.
DEVELOPMENT OF ALL WEATHER LANDING SYSTEM RELIABILITY ANALYSIS AND CRITERIA FOR CATEGORY III AIRBORNE SYSTEMS, PHASE III, VOLUME I Summary Report
L. A. Adkins, J. D. St. Clair, M. C. Thatro, and H. R. Willis May 1967 99 p refs
(Contract FA-65WA-1376)
(ER-8957; RD-67-20, Vol. I)

The results of a study program on Category III airborne All Weather Landing Systems are presented. The primary program effort was directed toward the evaluation of reliability, availability, safety, and human factors for airborne systems ranging from Simplex to multi-channel fail operative configurations. Included in the report are mathematical models depicting reliability and safety as a function of system configuration and operating parameters. From the reliability models, a computerized program is generated, presenting the reliability, availability, and safety of the various systems being considered for Category III landings. Also, as part of this program, a human factors error analysis was conducted to determine the probability of human error, based on the tasks required to perform a Category III landing. Using the results of the human error analysis and the airborne system reliability analysis, a safety model was derived that presents the probability of occurrence of a hazardous event. Author

N67-34606 Royal Aircraft Establishment, Farnborough (England).
ERROR OSCILLATIONS IN INERTIAL NAVIGATION SYSTEMS
W. J. Couperthwaite Mar. 1967 35 p refs
(RAE-TR-67053)

Inertial navigation system errors are analysed in more detail than is found in the readily available literature, particularly in respect of the long period errors. The existence is shown of oscillatory errors of three different periods: 84 minutes, a nominal 24 hours and a less important Foucault period. The basic equations are essentially non-linear and this limits the scope of the analytical approach. It is hoped to attempt a more complete computer simulation of the problem later. Author

N67-34618# Naval Air Development Center, Johnsville, Pa. Aero Mechanics Dept.
OPTIMIZATION OF DOPPLER DAMPING OF INERTIAL NAVIGATION SYSTEMS Phase Report
Steven R. Ellms 22 Dec. 1966 29 p refs
(NADC-AM-6657; AD-653865) CFSTI: HC $3.00/MF $0.65

A theoretical analysis was performed to determine the optimal gains for a linear velocity-damped second order inertial navigation system. Experimental data was collected by utilizing the theoretically optimum gains in a typical inertial system. The theoretical analysis was verified by experimental results. Author (TAB)

N67-34756*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
STATISTICAL INERTIAL NAVIGATION
Gerald E. Steinker (Ph.D. Thesis) Sep. 1966 182 p refs
(Grant NsG-496)
NASA-CR-87799; CSR-T-67-2) CSCL 17G

Inertial navigation of vehicles during short time intervals for which the predominant accelerations non-gravitational is discussed. Due to the high time correlations of random errors associated with an inertial measurement unit, it is possible to assume accelerometer measurements which are perfect except for random constant error coefficients. Statistical estimation theory is applied to navigation systems with assumed perfect measurements and the estimation errors associated with such a statistical navigation system are compared with errors derived from conventional deterministic navigation systems. The design and effectiveness of the statistical navigation system depend on the number of independent white noise elements driving the non-gravitational or specific force accelerations. If this number is equal to or less than the number of measurements observed, the estimation errors of the statistical system are shown to asymptotically approach zero. Development of a statistical navigation system for an Apollo re-entry mission is presented. Author

N67-34897*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
A LINEARIZED ERROR ANALYSIS OF ONBOARD PRIMARY NAVIGATION SYSTEMS FOR THE APOLLO LUNAR MODULE
Jerrold H. Suddath, Robert H. Kidd, III, and Arnold G. Reinhold Washington, NASA, Aug. 1967 26 p refs
(NASA-TN-D-4027) CFSTI: HC $3.00/MF $0.65 CSCL 17G

The accuracies which could be expected from onboard primary navigation systems for the lunar module following the concentric flight plan were determined. Emphasis was placed on comparing a rendezvous radar with an optical tracker as a source of navigational information. The comparison was drawn from linearized error analyses of the navigation systems as they would function in various phases of the concentric flight plan. The results of the investigation indicate that there is little difference between rendezvous radar and optical tracker performance in the primary navigation system in terms of navigation accuracy. Furthermore, for either sensor, the effect of reduced accuracy and the effect of varying the measurement sampling period on navigation accuracy are of little significance. Author

N67-35092# European Space Research Organization, Paris (France).
OPERATION OF AN AUTOMATIC PILOT OF EXTREMELY HIGHER PRECISION FOR ASTRONOMICAL SATELLITE RESEARCH [LAGEREGELUNG EXTREM HOHER GENAUIGKEIT FUR ASTRONOMISCHE FORSCHUNGSSATELLITEN]
Heinz Busch 1966 20 p In GERMAN Presented at DGRR Symp. on Satellite Technol. II, Munich, 8 Dec. 1966 (No. 66-123)

Requirements and characteristics of attitude and stability control systems for satellites used for measuring the electromagnetic spectrum of stellar radiation are discussed. Three solar and stellar sensor systems for satellite stability and control are described: the system of the U.S. OAO satellite, that of the European Large Astronomical Satellite (LAS) project, and a modified principle which aims to simplify construction and increase reliability. The improved principle differs from the other two systems mainly in construction and function of the reference system. This reference system consists of a sun sensor with three overlapping sensing angles which vary in sensitivity. The housing of the sun sensor also contains two stellar sensors with a sensing angle of 1° and a guidance accuracy of ±5". Operation and practical application of this stability and control system are briefly outlined. Transl. by K.W.

N67-35154* TRW Systems, Redondo Beach, Calif.
EVALUATION OF A SEMI-ACTIVE GRAVITY GRADIENT SYSTEM
R. G. Nishinaga and P. C. Wheeler 1 Oct. 1965 188 p refs
(Contract NAS5-9640)
(NASA-CR-87422; QR-1; TRW-4488-6003-TU000) CSCL 22B

The vehicle configuration assumed is that of a scaled down (smaller and lighter) Nimbus. A major departure from the Nimbus structural configuration is the probable presence of a two-degree-of-freedom solar array. The additional array freedom compensates for the satellite's lack of yaw maneuverability. The factors considered in selecting a structural configuration for these investigations are developed. After discussing the problems associated with acquisition following a spinning injection, a preliminary acquisition sequence in presented. The small-error aspect of the control problem is treated by performing stability analyses and frequency response evaluations using simplified linearized equations. Finally, mechanization considerations are discussed with emphasis on implementation of the reaction wheel/motor assembly and its suspension. The most significant conclusion to date is an indication that a single (roll) degree-of-freedom wheel suspension will give small error performance superior to any other suspension configuration. Author

N67-35171 Royal Aircraft Establishment, Farnborough (England).
METHODS OF COSTING DEVIATIONS FROM THE OPTIMUM CRUISE FLIGHT PATH, WITH EXAMPLES FOR THE LONDON–NEW YORK ROUTE
V. W. Attwooll May 1966 72 p refs
(RAE-TR-66148)

For given weather conditions there is a best flight path and altitude for any particular aircraft flying from London to New York, but to accommodate the traffic flow many aircraft must accept a deviation to another flight level or track parallel to the best one. This usually increases the fuel consumption, and sometimes also the flight time for the trip, which in combination can be represented as extra operating cost to the airlines. Methods are given for costing these deviations, and various aspects such as the reliability and use of the cost estimates are discussed. The relative incidence of the various deviations is briefly discussed, but methods for establishing this and detailed assessments of it are left for another paper. Specimen penalties are given for five types of subsonic jet aircraft for deviations up to 8000 feet in altitude and 5 degrees in latitude. Supersonic transport is also considered, and some detail given for a Mach 2 transport aircraft. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N67-34003# Aktiebolaget Atomenergi, Stockholm (Sweden).
FINITE-GEOMETRY AND POLARIZED MULTIPLE-SCATTERING CORRECTIONS OF EXPERIMENTAL FAST-NEUTRON POLARIZATION DATA BY MEANS OF MONTE CARLO METHODS
O. Aspelund and B. Gustafsson Jun. 1967 73 p refs
(AE-284) CFSTI: HC $3.00/MF $0.65

Various methods for correcting experimental lift-right ratios for polarized multiple scattering and finite geometry effects are discussed. Formulas are derived for consistent tracking of polarization effects in successive scattering orders. It is assumed that the scattering is elastic and nuclear, and that in the description of the kinematics of the arbitrary scattering μ only the spin rotation parameter $\beta^{(\mu)}$ is required. The importance of the correct inclusion of polarization effects in any scattering order is discussed, with emphasis on the depolarization of an already polarized beam. The formulas are incorporated in the Monte Carlo program MULTPOL, which accounts for finite geometry effects. A special feature of MULTPOL is the application of the correlated sampling method for reducing standard deviations of the results of the simulated experiment. Typical performance data of MULTPOL were obtained by applying it to the correction of polarization data observed in $n + {}^{12}C$ elastic scattering between 1 and 2 MeV. The possible modification of MULTPOL to other experimental geometries is briefly discussed. Author

N67-34011# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
REACTIVITY WORTH OF CONTROL RODS IN THE BERYLLIUM OXIDE MODERATED PEBBLE BED REACTOR
N. Spinks Feb. 1967 13 p refs
(AAEC/TM375) CFSTI: HC $3.00/MF $0.65

Preliminary and final studies are reported for the worth of tubular control rods in a beryllium oxide moderated pebble bed reactor system. In the preliminary study the consideration of ball flow forces the investigation of a number of control rod arrangements. In addition a range of rod sizes is considered. In the final study a particular rod size and pattern is chosen for more detailed investigation. For the intermediate reactor cores under consideration the control rods must absorb appreciably in the keV region. A feature of the final study is the accurate way the epithermal absorption can be taken into account while using a three group model in the reflected reactor. The preliminary study is not so accurate but is useful for comparative purposes. Author

N67-34032# Aktiebolaget Atomenergi, Stockholm (Sweden).
A BURNOUT CORRELATION FOR FLOW OF BOILING WATER IN VERTICAL ROD BUNDLES
Kurt M. Becker Apr. 1967 98 p refs
(AE-276)

A rod bundle burnout correlation is described which is a development from an earlier published rod bundle correlation for low pressures. The correlation is based on the Becker round duct correlation and is written in the form $x_{BO}=0.68\cdot\eta\cdot\eta_1\cdot x_{RD}$ where x_{RD} is the burnout steam quality in a round duct at corresponding flow conditions, η is the ratio of heated to total perimeter, and η_1 is a correction factor, which is a function of q/A only. This equation combined with the heat balance equation $q/A=G/4L/D_H\,[\Delta h_{sub}+x_{BO}\,h_{fg}]$ predicts the burnout heat fluxes for 312 laboratory measurements within a scatter of ±7.5% and with an RMS error of 3.8%. The correlation shows that the burnout conditions in wide ranges of variables are independent of the inlet sub-cooling and the heated length, and that the effects of mass velocity and pressure are the same in rod bundles and in round tubes. The effects of a radial heat flux variation within the rod bundle can be handled by the correlation by modifying the η-value for the bundle. Author

N67-34042# European Atomic Energy Community, Brussels (Belgium).
NON-FUEL APPLICATIONS OF α-EMITTING NUCLIDES
J. Kooi Aug. 1967 45 p refs
(EUR-3498.e)

A critical survey is given of existing data concerning the application of heavy element α-active isotopes, other than their application as a new nuclear fuel. An attempt is made to extrapolate present data and trends, both from a technological as well as from an overall economic point of view. Attention has been drawn to a number of problems which urgently require further study. Author

N67-34073# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
POTENTIAL OF ADVANCED FUELS FOR A FAST TEST REACTOR
W. J. Bailey, P. D. Cohn, D. T. Aase, F. G. Foote, F. M. Heck et al 12 Jan. 1967 5 p refs Presented at the Am. Nucl. Soc. Meeting, San Diego, Calif., 11–15 Jun. 1967 Revised
(Contract AT(45-1)-1830)
(BNWL-SA-1042-S, Rev. B; CONF-670602-6, Rev. B) CFSTI: HC$3.00/MF$0.65

Potential advanced driver fuels for a fast test reactor were evaluated. These fuels consisted of seven carbide and eight alloy types. Fuel cycle parameters and reactor core designs were investigated with the MIDAS computer code. Fuel fabrication costs were examined. Predicted advantages of these fuels are presented. NSA

N67-34075# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
IN-REACTOR OXIDATION OF ZIRCONIUM ALLOYS IN pH-10 LiOH AND pH-10 NH OH_4
A. B. Johnson, Jr. [1967] 26 p refs Presented at the 23d Ann. Conf. of the Natl. Assoc. of Corrosion Engr., Los Angeles, 13–17 Mar. 1967
(Contract AT(45-1)-1830)
(BNWL-SA-822; CONF-670312-2) CFSTI: HC$3.00/MF$0.65

Results of in-flux corrosion studies in the G-7 loop of the Engineering Test Reactor are summarized. Corrosion data were obtained from tensile specimens and from coupons of two sizes. Six Zr alloys were exposed in various combinations in three G-7 loop environments: pH-10 LiOH, ≈1 ppm O_2, pH-10 LiOH, ≈0.1 ppm O_2 and pH-10 NH_4OH, <0.05 ppm O_2. Alloys exposed in the lithiated environments consistently underwent pronounced flux-induced oxidation. In the ammoniated environment, flux-induced oxidation was small or absent on specimens exposed as-etched. However, three of six alloys exposed after prefilming at 400°C in 1500 psi steam underwent considerable flux-induced oxidation. Specimens prefilmed at 300°C also show accelerated oxidation, but not to the degree observed on specimens prefilmed at 400°C. Specimens exposed at G-7 loop out-of-flux positions ≈ sec and ≈1 min from the flux did not differ significantly in oxidation rate or hydrogen pickup. Hydrogen pickup was not significantly accelerated by flux unless the oxidation rate was affected. Exposures in the irradiated ammoniated coolant also show little effect of the H_2 in the coolant on hydrogen pickup after 77 days. Results from the G-7 loop exposures and from Zr alloy corrosion in other reactors are consistent with the view that accelerated oxidation is dependent on the dissolved O_2 level in the coolant. Author (NSA)

N67-34076# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
POTENTIAL OF ADVANCED FUELS FOR A FAST TEST REACTOR
W. J. Bailey, P. D. Cohn, D. T. Aase, F. G. Foote, F. M. Heck et al 12 Jan. 1967 5 p refs Presented at the Am. Nucl. Soc. Meeting, San Diego, Calif., 11–15 Jun. 1967 Revised
(Contract AT(45-1)-1830)
(BNWL-SA-1042-S, Rev. A; CONF-670602-6, Rev. A) CFSTI: HC$3.00/MF$0.65

The basis for comparison was an 800-liter, mixed-oxide-fueled core. Fuel cycle parameters and reactor core designs were investigated using an adaptation of the MIDAS computer code. Results indicate that mixed carbides and alloy fuels such as U–Pu–Zr offer potential advantages as advanced driver fuels for fast test reactors. Results of computer analyses of potential carbide and alloy fuels are tabulated. NSA

N67-34077# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
STATUS OF PROGRAMS FOR BEHAVIOR OF IRRADIATED MATERIALS IN LIQUID SODIUM FAST BREEDER REACTORS
T. T. Claudson [1966] 27 p Presented at the ASME 1966 Winter Ann. Meeting, New York, 27 Nov.–1 Dec. 1966
(Contract AT(45-1)-1830)
(BNWL-SA-972; CONF-661102-34) CFSTI: HC$3.00/MF$0.65

The status of advanced materials for the reactors is summarized. Information is included on development programs such as those associated with the Fast Flux Test Facility and the Liquid Metal Breeder Reactor Program. The major Na technology programs at BNWL, GE, MSAR, BNL, AI, APD, ANL, LASL, WAPD, and NRL are summarized. NSA

N67-34102# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
CANDU-BLW EXPERIMENTS IN ZED-2. PART III: BUCKLING AND LOSS OF COOLANT EXPERIMENTS
R. E. Green, R. E. Kay, and C. W. Colpitts May 1967 45 p refs
(AECL-2691) CFSTI: HC$3.00/MF$0.65

Experiments have been performed in simulated CANDU-BLW lattices in ZED-2 (square arrays of 28-rod UO_2 clusters at a spacing of 27.94 cm) to determine the material buckling of the lattice with H_2O or air as coolants, and the flux perturbation and reactivity effects of removing the H_2O coolant from 50% of the fuel assemblies in three geometric arrangements. The buckling for the H_2O-cooled lattice was 1.166 ± 0.018 m^{-2}, and for the air-cooled lattice 3.949 ± 0.039 m^{-2}. The loss of coolant experiments indicated a significantly smaller increase in reactivity when alternate fuel assemblies or alternate rows of fuel assemblies were voided than when one-half of the lattice about a diameter was voided. Author

N67-34117# Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Forschungsreaktoren.
PROGRAMMED CONSUMPTION DETERMINATION AND REACTIVITY ESTIMATION FOR THE FUEL UTILIZATION IN THE RESEARCH REACTOR FRJ-2 (DIDO) [PROGRAMMIERTE ABBRANDBESTIMMUNG UND REAKTIVITAETSABSCHAETYUNG FUER DIE BRENNSTOFFNUTZUNGAM FORSCHUNGSREAKTOR FRJ-2 (DIDO)]
H. J. Bormann and E. Muench Jan. 1967 33 p refs In GERMAN
(JUL-456-RE)

A method and a digital computer program are described for obtaining burnout values, changes in reaction, heating surface loads, and position-weight factors from the measured flux density distributions in the burner elements of the experimental reactor FRJ-2 (DIDO). Explained are the theoretical bases, the experimental method, and the computer program, and a representative period of operation of the reactor is used as input data to demonstrate the computer program. The method is applicable to all reactors similar in construction to the FRJ-2 and in whose core flux density measurements can be made during operation. Transl. by K.W.

N67-34187# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
DIFFERENTIAL NEUTRON ENERGY SPECTRUM MEASUREMENTS ON U233/BeO AND U235/BeO ASSEMBLIES IN THE REACTOR MOATA
R. B. Tattersall Mar. 1967 74 p refs
(AAEC/E171) CFSTI: HC$3.00/MF$0.65

Differential spectrum measurements were made on a series of U233 and U235 fuelled, beryllia moderated assemblies with fuel to moderator atomic ratios ranging from 1/6500 to 1/700. A preliminary comparison was made with calculations of the spectra. In the thermal region, fair agreement was found for the U235 lattices, but for U233 the experimental thermal flux was significantly higher than that calculated. In the epithermal region above 50eV, the experimental flux was higher than that calculated for the U235 assemblies, but was in reasonable agreement with calculation for U233. Author

N67-34213# Los Alamos Scientific Lab., N. Mex.
DECALIBRATION OF A TUNGSTEN-TUNGSTEN 25% RHENIUM THERMOCOUPLE IN A NEUTRON FLUX
S. R. Skaggs, W. A. Ranken, and A. J. Patrick 31 Mar. 1967 7 p refs Presented at 3d Intern. Ceram. Radiation Symp., Miami, Fla., 29 Aug.-10 Sep. 1964
(Contract W-7405-ENG-36)
(LA-3662; CONF-632107) CFSTI: HC$3.00/MF$0.65

A determination was made of the change in thermoelectric emf of a W/W-25Re thermocouple resulting from irradiation at an average temperature of 2000°K for 5328 hr in a thermal flux of 2.0×10^{13} n/cm^2-sec for a total exposure of 3.8×10^{20} nvt. Comparison of the postirradiation thermoelectric output with that of an unirradiated thermocouple from the same batch showed that the thermal emf was increased by the combination of transmutation and phase separation due to irradiation at temperature. This change is noted over the entire range from room temperature to 2170°K. The difference in temperature required to generate the same thermal emf for the irradiated and unirradiated thermocouple varied from 60°K at 1200°K to 33°K at 2170°K. The lack of agreement of this measurement with investigations at General Electric Nuclear Materials and Propulsion Operation using simulated W-Re-Os alloys based on calculated compositions may be due to the separation observed in our experiment, of the W-Re leg into two phases, one of which contained a much higher relative proportion of osmium than the other. Author (NSA)

N67-34214# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
BUCKLING AND INTEGRAL SPECTRUM MEASUREMENTS IN Pu239/BeO SUB-CRITICAL ASSEMBLIES
P. Duerden Jun. 1967 46 p refs
(AAEC/E177) CFSTI: HC$3.00/MF$0.65

The materials buckling of four BeO moderated Pu239/aluminium-alloy fuelled systems having BeO/Pu239 atomic ratios of 1707, 2499, 3749 and 4999 have been measured by the exponential method. Relative fission rates of U233, U235 and Pu239 were also measured in the equilibrium spectrum region of the same assemblies. Because of the heterogeneous nature of the assemblies, fine structure corrections were applied. Some calculations using the CRAM diffusion code, and some using the GYMEA code are included. Author

N67-34219 Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
THE EXPERIMENTAL DESIGN OF TESTS TO MEASURE THE THERMAL STRESS RESISTANCE OF SPHERICAL CERAMIC FUEL ELEMENTS FOR NUCLEAR REACTORS
J. C. M. Jones Nov. 1966 38 p
(AAEC/E165)

The statistical and thermodynamic problems introduced in quench testing the thermal stress resistance of spherical cerámic fuel elements for nuclear reactors are analyzed. The statistical problem is one of deciding how many specimens to quench in order to achieve a required confidence interval in the working stress deduced from the test. Two methods are considered: quantal response and the up-and-down methods. Estimates of confidence interval associated with a range of sample sizes are obtained by a computer simulation technique. It is shown that sample sizes of several hundred specimens would be required in order to obtain confidence intervals compatible with demands of reactor design. The thermodynamic problem is one of predicting the specimen temperature distribution from which the stress may be calculated. A solution for the case of the single specimen is already available. Multiple specimens, which offer the advantage of shortening the time scale of the experiment, introduce the problem of a time dependent quenchant temperature; a solution, in terms of heat regenerator theory, is presented. Author

N67-34225# Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung.
THE SPHERICAL PILE REACTOR AS A THERMAL THORIUM BREEDER. I: GRAPHITE AS MODERATOR [DER KUGELHAUFENREAKTOR ALS THERMISCHER THORIUM-BREUTER. I: GRAPHIT ALS MODERATOR]
S. Brandes Jan. 1967 46 p refs In GERMAN
(JUL-474-RG)

The breeder characteristics of a graphite-moderated high-temperature reactor of the spherical-pile type are examined for

the thorium-232–uranium-233 breeding cycle in order to minimize doubling times. Starting point of the analysis is the equilibrium condition of the fuel cycle in the reactor core. The BABS computer program was used for the calculations after it had been extended and improved. The effects of cooling time and regeneration losses on breeder properties, and of regeneration methods on the doubling time, are discussed. It is concluded that the graphite-moderated high-temperature thorium reactor is poorly suited for use as a breeder. Only an infinite doubling time can be attempted, in which case the possible burnup may reach the order of 20,000 to 30,000 MW d/t assuming water regeneration of the fuel. Transl. by K.W.

N67-34239# Battelle Memorial Inst., Columbus, Ohio.
AN EVALUATION OF THE APPLICABILITY OF EXISTING DATA TO THE ANALYTICAL DESCRIPTION OF A NUCLEAR-REACTOR ACCIDENT Quarterly Progress Report, Jan.–Mar. 1967
David L. Morrison, Samuel J. Basham, Joachim N. Blutreich, Wayne A. Carbiener, William E. Clark et al 1 Apr. 1967 56 p refs
(Contract W-7405-ENG-92)
(BMI-1797) CFSTI: HC $3.00/MF $0.65

Analysis of a loss-of-coolant accident in a 1000 MW(e) boiling water reactor was done by the use of NURLOC computer code. The results of these calculations were compared to other calculations of the LOFT accident. Thermal and transport properties of steam, hydrogen, and steam–hydrogen mixtures at elevated temperatures were evaluated for use in metal–water reaction analysis. A simple generalized fission-product-release model for a reactor was developed for use in estimating the fission-product release in loss-of-coolant accidents. Effect of numerous processes on the general character of fission-product release is evaluated; a rough estimate of the effect of heat-source depletion on core melt-down rates was obtained. Calculations of molecular iodine release from a pressure-vessel planum chamber were extended to include examples of large BWR and PWR systems. NSA

N67-34285# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
CROSS-FLOW MIXING BETWEEN PARALLEL FLOW CHANNELS DURING BOILING. PART I: COBRA: COMPUTER PROGRAM FOR COOLANT BOILING IN ROD ARRAYS
D. S. Rowe Mar. 1967 112 p refs
(Contract AT(45-1)-1830)
(BNWL-371, Pt. 1) CFSTI: HC $3.00/MF $0.65

A mathematical model and digital computer program for computing coolant flow and enthalpy in the subchannels of rod bundle fuel elements is presented. One dimensional, two-phase, slip flow in the subchannels provides the basis for the mathematical model. The model also includes the effect of mixing that occurs through the gap between adjacent subchannels by using a turbulent (fluctuating) cross-flow and a diversion cross-flow that results from flow redistribution. The digital computer program COBRA solves the mathematical equations by using numerical procedures similar to the modified Euler method, but with an additional feature to control diversion cross-flow and insure a stable solution. COBRA considers both single and two-phase flow in rod bundles of arbitrary geometry and can consider up to 36 subchannels and 25 fuel rods. Arbitrary heat flux distributions are specified by the axial flux distribution, relative rod power and fraction of rod power to each adjacent subchannel. Author (NSA)

N67-34272 Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung.
DETERMINATION OF THE DISPERSION MATRICES FOR THE MATERIALS OF THE MOSEL REACTOR [BERECHNUNG VON STREUMATRIZEN FUER DIE MATERIALIEN DES MOSEL-REAKTORS]
H. Gerwin Oct. 1966 124 p refs In GERMAN
(JUL-419-RG)

New scattering data were derived for elements and isotopes, particularly for those used in the epithermic molten-salt reactor (MOSEL) of this facility. A computer program was written in which the mean flux for the individual groups can be set at any desired value and which is used to evaluate and calculate new scattering matrices. In addition, the effect of the new scattering data and the various mean spectra on the criticality and on the mean number of neutrons per absorption in U-233 was examined in a hard and soft MOSEL arrangement. Transl. by K.W.

N67-34273# Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe.
THE INFLUENCE OF REACTOR RADIATION ON THE AGING BEHAVIOR OF AN Al 4% Cu ALLOY [DER EINFLUSS VON REAKTORBESTRAHLUNG AUF DAS AUSLAGERUNGS-VERHALTEN EINER Al-4% Cu-LEGIERUNG]
K. D. Olshausen Jan. 1967 108 p refs In GERMAN
(JUL-448-RW) CFSTI: HC $3.00/MF $0.65

An aluminum alloy with 4 wt/% copper was homogenized and quenched at 100°, 150°, 200°, 250°, and 300°C, placed into the reactor for aging, and measured for changes in the electric resistance. An acceleration of the diffusion due to the radiation was not observed, but a reduction in the speed of formation of the Guinier–Preston zones was noted during the initial phase of the 100° aging. This is probably due to an accelerated filling of the lattice vacancy, frozen during the quenching, by recombination of interstitial atoms. At 150° aging this effect becomes secondary to the destruction of the θ'' zones by defect cascades; the θ'' zones are formed after 1 to 2 days. This results in an initial resistance loss followed by an increase, which again turns to a loss when the formation of the larger and more stable θ' phase commences. No noticeable deviations occur in the temperature range between 200° and 300°C, since the θ' phase is eliminated at the outset. Measurement of a 25° isotherm under electron irradiation revealed an accelerated formation of Guinier–Preston zones, indicated by the early commencement and steep increase of the resistance gain. This is thought to be due to an increased diffusion because of greater hole concentration. Transl. by K.W.

N67-34284# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
WORTH OF BORON ROD IN THE REACTOR MOATA
N. Spinks Jun. 1967 20 p refs
(AAEC/E181) CFSTI: HC $3.00/MF $0.65

The U^{235} fuel increase required to compensate for the insertion in Moata of an enriched boron rod is measured. The DIFF code is used to calculate the mass increase and comparison with the experimental result provides a check on the theory incorporated in the code. In addition to the experimental check, a simplified calculational mock-up of the experiment is used as the basis of a more detailed comparison between the diffusion theory and transport theory. The worth of the rod as calculated by the diffusion theory is high by 10 per cent when compared to experiment and low by about 3 per cent when compared to transport theory. In general, the neutron fluxes calculated by the diffusion theory agree to within 2 per cent with those from transport theory. Author

N67-34287# Oak Ridge National Lab., Tenn.
REACTOR CHEMISTRY DIVISION Annual Progress Report, for Period Ending Dec. 31, 1966
Mar. 1967 202 p refs
(Contract W-7405-ENG-26)
(ORNL-4076) CFSTI: HC $3.00/MF $0.65

Continuing research is discussed in the areas of molten-salt reactors, aqueous reactors, gas-cooled reactors, nuclear safety, and related fields. Chemical and physical properties of fuels and materials are investigated, and the effects of radiation are included. Details are given on various chemical support activities. Safety tests in major facilities and laboratory-scale supporting studies are discussed. N.E.N.

N67-34328# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
TEMPERATURES AND THERMO-ELASTIC STRESS IN SPHERICALLY SYMMETRIC FUEL ELEMENTS WITH VARYING MATERIAL PROPERTIES
Ian M. Binns Feb. 1967 26 p refs
(AAEC/TM371) CFSTI: HC $3.00/MF $0.65

In the thermoelastic stress analysis of a spherically symmetric fuel element as used in a pebble bed reactor the problems of a radial variation in material properties and the temperature dependence of these properties can be unified into a single analysis. Such an analysis is developed for incorporation in a computer program and applied, as an example, to a fuel element for a beryllia moderated reactor. The results give the effect of different material properties between surface and center, a buffer layer between surface coating and center, an increase in temperature of a fuel element composed of materials with different properties, and temperature dependence of the fuel element materials. Author

N67-34366# Ente Nazionale Per l'Energia Elettrica (ENEL), Rome (Italy).
THE EFFICIENCY OF THE ABSORBERS IN THE LATINA REACTOR [L'EFFICACIA DEGLI ASSORBITORI NEL REATTORE DI LATINA]
G. Giannini, G. Lesnoni, M. Paoletti Gualandi, and B. Zaffiro Brussels, EURATOM, Jun. 1967 58 p refs In ITALIAN; ENGLISH summary
(Contract EURATOM-050-65-I TEGI)
(EUR-3487-I) CFSTI: HC $3.00/MF $0.65

Long-term variations in the reactivity of the Latina reactor are controlled by altering the weight and number of absorber channels in the core. Described are the measures taken at 1100 and 1500 MWd/t respectively, and the methods used to elaborate the experimental data. Also described are the method of calculating the reactivity controlled by the absorbers and the distributions of interest for purposes of preparing the experimental data, together with the results of a comparison of theoretical and experimental findings. Author

N67-34384# Centre d'Etude de l'Energie Nucléaire, Mol (Belgium).
THERMOCOUPLE FAILURES IN GRAPHITE IRRADIATION RIGS FOR BR 2 REACTOR, MOL
M. Petane Brussels, EURATOM, Jun. 1967 18 p refs
(Contract EURATOM-006-60-5 BRAB)
(EUR-3491.e) CFSTI: HC $3.00/MF $0.65

It was found that an adverse combination of the thermocouple sheath material, the purity of the insulation used for the thermocouple wires and the ambient atmosphere during irradiation, can give the sort of destruction observed in these thermocouples during the disassembly of the experimental device in the hot cell. Author

N67-34405# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
MICROWAVE DETECTION OF MOISTURE IN REACTOR COOLANT GAS Interim Report
D. P. Brown and T. R. Billeter May 1967 20 p refs
(Contract AT(45-1)-1830)
(BNWL-406) CFSTI: HC $3.00/MF $0.65

The use of microwaves to detect and measure the moisture content of gases used for cooling reactors was investigated. The detection sensitivity is limited by the stability of the microwave generator, its associated references, and the ability to measure frequency changes. At room temperature, the change in the dielectric constant of the gas mixture is measured by the change in the resonant frequency of a microwave cavity through which the gas flows. Detection sensitivity is 85 ppm change at concentrations of 400 ppm water vapor in helium. Because the dielectric constant is a function of temperature, an increase in temperature will decrease the dielectric constant and will reduce detection sensitivity. At 436°C, the detection sensitivity was 875 ppm of water vapor in helium. Author (NSA)

N67-34420# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.
THE DATA REQUIREMENTS OF THE TRIANGULAR MESH NEUTRON CODES TRIFID AND RAVEN
C. W. J. McCallien [1967] 32 p refs
(TRG-1374(R)) CFSTI: HC $3.00/MF $0.65

Trifid is a Fortran IV program which solves the two-dimensional few-group source-sink equations appropriate to a graphite moderated reactor with a triangular lattice. Raven is the name given to a large section of the program which calculates one term in the equations. Both Trifid and the subsidiary Raven can accommodate sufficient mesh points to represent the Windscale advanced gas-cooled reactor (WAGR) or HERO reactor, in three groups, with one mesh point per reactor channel. The program may also be used as a general triangular mesh diffusion code. In addition long term reactivity calculations for WAGR may be performed. At the start of each time step the irradiations at different points in three dimensions are known and the corresponding values of the cross sections may be calculated. These are averaged over each channel and the two-dimensional diffusion equations solved. The channel powers can then be found in terms of the fluxes, and finally the changes in irradiation occurring during the time step can be computed. Unirradiated fuel may be loaded, and irradiated fuel may be either unloaded or moved to a new position, between time steps. In this report the principal equations are stated and the data requirements are specified in detail. Examples of the data for three kinds of problems are given in an appendix along with an example of the printed output from the program. Author

N67-34428# United Kingdom Atomic Energy Authority, Dounreay (Scotland). Experimental Reactor Establishment.
AN ANALYSIS OF THE COMMISSIONING TESTS OF THE DELAYED NEUTRON MONITOR ON THE D.M.T.R. BOILING WATER LOOP
E. W. Etherington [1967] 21 p refs
(TRG-1416(D)) CFSTI: HC $3.00/MF $0.65

The construction of the delayed neutron monitors now in use with the boiling water loop in D.M.T.R. is very simple. It consists essentially of three BF_3 counters placed near to the steam/water separator. This provides a large reservoir which has a short delay time from the in-pile section of the loop, so ensuring a relatively large signal. The system has been tested using the signal arising from ^{17}N and from the uranium contamination of the fuel cans and the results have been compared with a detailed theoretical analysis of its operation. These tests established that the minimum detectable signal was that from a hole of effective area about 0.01 cm^2 at position of maximum flux. Author

N67-34487 Atomic Energy Establishment, Trombay (India).
UTILIZATION OF THORIUM IN POWER REACTORS
B. P. Rastogi 1966 29 p refs Presented at Trombay Colloq., 13 Sep., 1966
(AEET-269)
Presented is a survey on the utilization of thorium in power reactors which includes data on: reactor physics; theoretical comparisons of several 1000 MW(e) systems which use thorium fuel; the potential and status of reactor concepts; reactor technology; and fuel processing and fabrication. S.C.W.

N67-34493 Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
FORTRAN IV PROGRAMMES FOR COMPUTATION OF TEMPERATURE AND THERMOELASTIC STRESS IN A HOMOGENEOUS SPHERICAL FUEL ELEMENT DUE TO AXISYMMETRIC HEAT TRANSFER VARIATION OVER THE SURFACE
Z. J. Holy Feb. 1967 42 p refs
(AAEC/TM366)
Computer programs, together with a brief outline of the theory, are presented which enable computation of temperature and thermoelastic stress fields in homogeneous spherical fuel elements due to axisymmetric heat transfer variation over the surface. Uniform heat generation in the fuel element is assumed. Author

N67-34532# United Kingdom Atomic Energy Authority, Dounreay (Scotland). Experimental Reactor Establishment.
DESIGN, DEVELOPMENT AND MANUFACTURE OF NEUTRON CONVERTORS FOR D.M.T.R.
W. R. Lorimer and T. G. Pearson 1967 24 p ref
(TRG-1453(D)) CFSTI: HC $3.00/MF $0.65
Three designs of neutron convertors have been manufactured for use in the Dounreay materials testing reactor. Two were for installation in 4VGR facilities and the third in a 4V facility hole. A further type is at present being designed for use in a 7V facility. Experience with the first convertor highlighted difficulties and indicated areas of improvement in design concepts. A description of the designs together with manufacturing and commissioning experiences are presented, also the solutions adopted in overcoming difficulties. Author

N67-34579# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
THE SPACE DEPENDENT TREATMENT OF PEBBLE BED REACTOR FUEL MANAGEMENT USING THE BURNUP CODE FRIZLE
E. W. Hesse Mar. 1967 40 p refs
(AAEC/E173)
An outline is given of the model used in the FRIZLE code complex in order to treat the two dimensional space dependent fuel management problem. The model is an extension of the zero dimensional burnup model, which allows the linking up of some existing codes. The code complex is capable of determining, for all envisaged pebble bed reactor fuel management schemes, the core power distribution based on the calculated average composition and temperature in specified core zones. The code is used for assessing several practicable management schemes applicable to a pebble bed reactor. These show that the same achievable burnup is obtained as with the zero dimensional method, based on the assumption of infinite recirculation. However, because of the markedly different core power distributions produced by various schemes, it is more important to arrange the management to reduce the core size and capital cost, than to increase burnup. Details are given of the code complex and data requirements. Author

N67-34676# Atomics International, Canoga Park, Calif.
S8DS VARIABLY SPACED CORE, EVALUATION, AND DESIGN
R. H. Tromel 5 Jan. 1967 19 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-12295) CFSTI: HC $3.00/MF $0.65
In the current S8DR, design flow is shaped by a baffle to optimize reactor performance. Pressure drop of the core is large due to the relatively high coolant velocities required. An alternate flow shaping technique involves varying the element spacing to obtain a flow area variation. When a uniform inlet and outlet pressure is provided for all channels, the flow rates are calculable from channel area relations. The variable area technique has been applied to the S8DR core and core pressure drop can be reduced. Implementation of the variable area core requires the S8DR lower plenum flow asymmetry be smoothed to obtain the uniform pressure condition. This flow shaping technique offers the potential of considerably reduced reactor pressure drop and an analytical method of designing flow shaping. Author (NSA)

N67-34682# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
A STUDY OF THE EFFECTIVE RESONANCE INTEGRAL AND DOPPLER COEFFICIENT OF U238, Th232, AND Pu240 USING THE CODE COMPLEX LUBRA
A. Keane and E. Kletzmayr Dec. 1966 34 p refs
(AAEC/E168)
The effective resonance integral and Doppler coefficient of U238, Th232, and Pu240 have been studied in detail using the LUBRA complex of codes. Some earlier results were used for comparison to verify the validity of the LUBRA results. Discrepancies have been explained and confidence can be placed in the results given by the LUBRA codes. Author

N67-34683# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
CALCULATION OF THE EFFECT OF FUEL PARTICLE SIZE ON REACTOR DYNAMICS
W. J. Turner and R. H. Piper Nov. 1966 18 p
(AAEC/E167)
The effect of fuel particle size on the dynamic behavior of a 500 MW beryllia moderated reactor fuelled with oxide particles of diameter 2 to 500 microns dispersed in beryllia is discussed. Negative feedback of reactivity proportional to the reactor power occurs because of the very small thermal time constant of the fuel particles. For large fuel particles, the feedback considerably reduces the peak power and the energy release following a reactivity accident. Author

N67-34757 Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
LUBRA—A CODE TO CALCULATE POINT AND GROUP CROSS SECTIONS EFFECTIVE RESONANCE INTEGRALS AND DOPPLER COEFFICIENTS FOR RESONANCE ABSORBERS IN HOMOGENEOUS REACTORS, USING BREIT–WIGNER SINGLE-LEVEL RESONANCE PARAMETERS
E. Kletzmayr Oct. 1966 105 p refs
(AAEC/E164)
The LUBRA complex of codes is designed to produce (i) point cross sections, (ii) infinitely dilute resonance integrals, (iii) effective resonance integrals based on the different approximations presently available and optionally modified to include particle size effects, (iv) Doppler coefficients, also based on the various models, and (v) group averaged cross sections, using Breit–Wigner single-level resonance parameters and other basic data only. The complex currently comprises five individual programmes coded in FORTRAN IV for an IBM 7040 computer and linked together by a specialised monitor system to permit the use of LUBRA as a single entity. Author

N67-34784# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

IRRADIATION PROPERTIES OF HIGH ENERGY RATE PNEUMATICALLY IMPACTED UO_2–PuO_2 FUELS

W. J. Bailey and M. D. Freshley Apr. 1967 40 p refs

(Contract AT(45-1)-1830)

(BNWL-356) CFSTI: HC $3.00/MF $0.65

Irradiation performance of test capsules and PRTR fuel elements containing pneumatically impacted UO_2–PuO_2 fuel material demonstrated that mixed oxides prepared by this process are comparable to or better than ceramic fuels prepared by other processes. The satisfactory performance was demonstrated for linear rod powers to 1276 W/cm (39 kW/ft) and to burnups as high as 5.91×10^{20} fissions/cm^3 (23,800 MWd/tonne). Structures formed during irradiation of pneumatically impacted UO_2–PuO_2 were similar to those formed during the irradiation of UO_2. Homogenization of the mechanically mixed PuO_2–UO_2 occurred at fuel temperatures sufficient to cause in-reactor sintering and grain growth. Good agreement was found between the fission gas release characteristics of capsules and full-sized PRTR elements. Fission gas release values of 90% were obtained for volumetric average fuel rod temperatures of 2200°C. NSA

N67-34806# Los Alamos Scientific Lab., N. Mex.

ADVANCED PLUTONIUM FUELS PROGRAM Quarterly Status Report, Jan. 1–Mar. 31, 1967

24 Apr. 1967 42 p refs

(Contract W-7405-ENG-36)

(LA-3686-MS; QSR-3) CFSTI: HC $3.00/MF $0.65

Developments are reported for studies on: release, distribution, and removal of fission products in Na coolant systems; measurement of impurities and development of quality control techniques for high temperature sodium coolant systems; kinetics of Na cold traps; ceramic Pu fuel materials; compatibility of Na-bonded (U,Pu)C and (U,Pu)N fuels with cladding materials; reactor nuclear analysis methods and concept evaluations; testing and evaluation of neutron cross sections for reactor calculations; and advanced measurement and analysis technology. NSA

N67-34811# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

FABRICATION OF ORGANIC LIQUID LOOP NO. 4 [FABRICATION DE LA BOUCLE A LIQUIDE ORGANIQUE NO. 4] Final Report

R. Pointud and F. Franzetti Brussels, EURATOM, May 1967 46 p refs In FRENCH; ENGLISH summary

(Contract EURATOM-081-62-10 ORGF)

(EUR-3456.f) CFSTI: HC $3.00/MF $0.65

The construction assembly and preliminary tests of the BLO 4 loop which is operating in the pool reactor SILOE, at Grenoble, France. A detailed description of the various components of the loop is presented in addition to a description of a mock-up for flux monitoring. Results obtained during preliminary tests in and out of pile are included. R.LI.

N67-34827# Martin Co., Baltimore, Md.

DISTRIBUTION OF HEAT AND PRESSURE ON THE SNAP 19 FUEL CAPSULE IN HYPERSONIC FLOW, VOLUME I

W. Lambert and T. Coughlin Mar. 1967 247 p refs

(Contract AT(30-1)-3607)

(MND-3607-93, Vol. I) CFSTI: HC $3.00/MF $0.65

Hypersonic pressure and heat transfer rate distribution tests on the SNAP-19 fuel capsule were conducted in the NASA Langley Research Center 31-inch continuous flow hypersonic tunnel. The objectives were to test theoretical methods of predicting the re-entry behavior of the fuel capsule. Data were ascertained for a nominal Mach number of 10, Reynolds number range of 0.5×10^6 to 1.7×10^6 per foot, and over an angle of attack of 0° to 90°. Two full-scale fuel capsule models were utilized, one for obtaining pressure data, and the other for obtaining the temperature histories necessary in finding heat transfer rates. NSA

N67-34878# Oak Ridge National Lab., Tenn. Isotopes Development Center.

RADIOISOTOPE SOURCE SAFETY TESTING

K. W. Haff, R. G. Niemeyer, R. A. Robinson May 1967 157 p refs

(Contract W-7405-ENG-26)

(ORNL-4092) CFSTI: HC $3.00/MF $0.65

The work of the Radioisotope Source Capsule Safety Testing Program, Oak Ridge National Laboratory (ORNL), through October 1966 is reported. Several hundred structural stress and temperature stress tests have been carried out on a wide variety of radioisotope source capsules. A method of classifying source capsules according to their containment integrity by using simple test procedures has been formulated. Author (NSA)

N67-34995# General Electric Co., Cincinnati, Ohio. Nuclear Technology Dept.

HIGH-TEMPERATURE MATERIALS PROGRAMS, PART A Annual Report, 31 Jan. 1966–31 Jan. 1967

31 Mar. 1967 300 p refs

(Contract AT(40-1)-2847)

(GEMP-475A; Pt. A; AR-6) CFSTI: HC $3.00/MF $0.65

Developments are reported for studies on: mechanical and physical properties of high-temperature reactor materials; radiation effects on fast reactor cladding and structural materials; fabrication of refractory metal alloys; physical metallurgy of refractory metal alloys; fabrication of advanced long-life reactor fuel cladding and structural materials; physico-chemical properties of Fe–Cr–Al clad fuel systems; radiation effects on heat-resistant metals and alloys; plastic fatigue properties of heat resistant alloys; advanced pressure vessel materials; physico-chemical properties of clad UO_2 in potential meltdown environments; preparation and properties of high-temperature thermocouple and electrical materials; high-temperature carbides for fuel and structural applications; and radiation effects on BeO. NSA

N67-35016# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.

ANALYSIS OF LATTICE EXPERIMENTS WITH LIQUID MODERATOR, USING A MODIFIED TWO-GROUP THEORY [ANALISIS DE EXPERIENCIAS DE RETICULADOS CON MODERADOR LIQUIDO, EMPLEANDO UNA TEORIA A DOS GRUPOS MODIFICADA]

Roberto Solanilla 1967 65 p refs In SPANISH; ENGLISH summary Submitted for publication

(CNEA-184) CFSTI: HC $3.00/MF $0.65

The computation of the effective multiplication from the geometric experimental observed bucklings in 141 regular lattices moderated and reflected with a liquid (heavy or light water) at the ambient air temperature, the basic fuel being natural uranium or slightly enriched in U-235 in cylindrical sheathed rods, is tabulated. Results show that a modified diffusion two-group theory generated by a condensation of a diffusion four-group model "standard" (with cross section adjusted from the detailed methods to diffusion multigroups and nuclear data) and with simplified formulisms for the latticed parameters treatment, employed in the interpretation of 141 exponential and critical experiments mentioned and described is in initial reactivities prediction, associated to "simple" systems moderated with light or heavy water and composed with regular "pressure vessel" type lattices. Author

N67-35019# United Kingdom Atomic Energy Authority, Harwell (England). Research Reactors Div.
THE DETERMINATION OF THE FAST-NEUTRON SPECTRUM IN POSITIONS IN THE DAPHNE REFLECTOR
M. G. Silk Mar. 1967 33 p refs
(AERE-R-5347) HMSO: 4s 6d

The difficulties inherent in spectrum determinations in reactors at positions remote from the core centre are considered, and the suitability of lithium-6 and helium-3 semiconductor sandwich spectrometers for this work is discussed. Spectra obtained in many positions in the DAPHNE reflector are compared with calculated spectra. Author

N67-35075 Joint Publications Research Service, Washington, D. C.
PROBLEMS OF HIGH-TEMPERATURE REACTOR OPERATION
31 Jul. 1967 65 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), no. 5, May 1967 p 362–378, 384–389, 413–415
(JPRS-42013; TT-67-32644) CFSTI: $3.00

CONTENTS:

1. CALCULATION OF REACTOR CORE TEMPERATURE WITH HEAT LIBERATION VARYING ARBITRARILY WITH CORE HEIGHT V. Ye. Minashin, A. A. Sholokhov, and Yu. I. Gribanov p 1–12 refs (See N67-35076 20-22)

2. CONTROL ROD OPERATION IN HIGH-TEMPERATURE REACTORS I. Ya. Yemel'yanov and R. V. Grebennikov p 13–22 refs (See N67-35077 20-22)

3. TEMPERATURE FIELDS OF FUEL ELEMENTS WITH LIQUID-METAL COOLANTS V. I. Subbotin, P. A. Ushakov, A. V. Zhukov, and V. D. Talanov p 23–38 refs (See N67-35078 20-22)

4. EFFECT OF TITANIUM ON PHASE CONSTITUTION AND DUCTILITY OF STEEL WITH HIGH CONTENT OF BORON R. V. Grebennikov, A. V. Chirkin, V. N. Vukolova, T. N. Shavrova, and I. S. Balanik p 39–50 refs (See N67-35079 20-17)

5. STUDY OF PHASE AND DIFFUSION RESISTANCE DURING CONDENSATION OF ALKALI METALS N. V. Bakulin, M. N. Ivanovskiy, V. P. Sorokin, V. I. Subbotin, and B. A. Chulkov p 51–57 refs (See N67-35080 20-33)

N67-35076 Joint Publications Research Service, Washington, D. C.
CALCULATION OF REACTOR CORE TEMPERATURE WITH HEAT LIBERATION VARYING ARBITRARILY WITH CORE HEIGHT
V. Ye. Minashin, A. A. Sholokhov, and Yu. I. Gribanov *In its* Probl. of High-Temp. Reactor Operation 31 Jul. 1967 p 1–12 refs (See N67-35075 20-22)

A method for the calculation of the surface temperature of heat elements using the heat transfer coefficient has been discussed. Errors appearing during such a calculation with a variable heat generation along the length of the active zone have been analyzed on an actual example. A second method for the temperature calculation of fuel elements with arbitrary heat generation distribution over their length is proposed based on the superposition principle. Practical recommendations are given concerning the temperature calculation by means of the Duhamel integral. The method is illustrated by an analysis of the existing experimental data concerning the temperature determination for a sinusoidal variation of heat flow along the tube length. Author

N67-35077 Joint Publications Research Service, Washington, D. C.
CONTROL ROD OPERATION IN HIGH-TEMPERATURE REACTORS
I. Ya. Yemel'yanov and R. V. Grebennikov *In its* Probl. of High-Temp. Reactor Operation 31 Jul. 1967 p 13–22 refs (See N67-35075 20-22)

The article presents some data concerning the operation and construction of high temperature rods and the absorbers used within these rods. Steel rods with boron alloy absorber having an operating temperature of 600°C are described; they move through dry channels with cooled walls. Other rods described here are made of graphite with a rare earth absorber used without special cooling in cores with graphite moderators heated up to 2,200°C. Author

N67-35078 Joint Publications Research Service, Washington, D. C.
TEMPERATURE FIELDS OF FUEL ELEMENTS WITH LIQUID-METAL COOLANTS
V. I. Subbotin, P. A. Ushakov, A. V. Zhukov, and V. D. Talanov *In its* Probl. of High-Temp. Reactor Operation 31 Jul. 1967 p 23–38 refs (See N67-35075 20-22)

Data gathered during experimental and analytical study of temperature fields and heat liberation in reactor cores with hexagonal contains are presented. Temperature fields of fuel elements located within the central zone and in the plane walls of the container are investigated. Certain conclusions are given concerning the overheating of fuel element enclosures under the spacers. Effects are described connected with the redistribution of heat carrier consumption across the container cross section during the transition from the turbulent to the laminar flow. Author

N67-35116# Atomics International, Canoga Park, Calif.
SNAP GENERAL SUPPORTING TECHNOLOGY Progress Report, Nov. 1966–Jan. 1967
L. S. Mims 5 May 1967 82 p refs
(Contract AT(04-3)-701)
(NAA-SR-12316) CFSTI: HC $3.00/MF $0.65

A summary of supporting technology for the SNAP program is given. The following areas of concentration are covered: reactor physics analyses including comparison of Be photoneutron decay sets, transport theory synthesis, cross section updating, and LOAFER documentation; dc conduction pump development; basic shielding analysis including STIR-experiments planning and analysis and shield code development; basic shielding experiments; basic shield materials technology including gamma shield development and lithium hydride technology; SNAP 10A FS-3 post test examination including both internal and external reflectors, core hold-down springs, handle bars, and reflector band; supersaturation studies with both cloud chamber and nozzle expansion. An evaluation of effort expended is presented. NSA

N67-35117# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Reactors Div.
COMPATIBILITY OF STABILIZED HYPOSTOICHIOMETRIC URANIUM–PLUTONIUM MONOCARBIDE FUELS WITH STAINLESS STEEL
W. R. Jacoby, R. G. Palm, and W. E. Ray Apr. 1967 36 p refs Prepared in cooperation with Argonne Natl. Lab.
(Contract AT(30-1)-3791)
(WCAP-3791-3) CFSTI: HC $3.00/MF $0.65

Unstabilized, Fe-stabilized, and $Cr_{23}C_6$-stabilized hypostoichiometric $(U_{0.8}, Pu_{0.2})C$ fuel pellets were fabricated and characterized. Compatibility couples of stabilized and unstabilized fuel pellets versus type-304 stainless steel pellets were tested for a minimum of 1000 hours at 800°C in both He and Ne

environments. No fuel-cladding interactions were observed at termination of the tests on the basis of metallographic evaluation.
Author (NSA)

N67-35119# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
RADIOCHEMICAL METHODS OF DETERMINATION OF NUCLEAR FUEL BURN-UP
M. Bezdek and J. Krtil Jan. 1967 33 p refs
(UJV-1633)
Methods for determination of the burnup of the nuclear fuel are surveyed. The influence of various factors on the accuracy of burnup determination is discussed as well as some formulas for burnup calculations. Maximum attention was centered on destructive methods of burnup determination, especially radiochemical methods for the preparation of radiochemically pure standards of various radioisotopes (for example ^{137}Cs, ^{144}Ce, etc.). The appliance of published radiochemical methods for burnup analysis is discussed.
Author (NSA)

N67-35137# Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Laboratorio Tecnologie dei Materiali.
DEVELOPMENT OF URANIUM-ALLOY FUEL-ELEMENT FABRICATION PROCESS [SVILUPPO DELLA TECNICA DI FABRICAZIONE DI ELEMENTI DI COMBUSTIBILE IN LEGHE DI URANIO] Final Report
B. Dalmastri and C. Fizzotti Brussels, EURATOM, May 1967 104 p In ITALIAN; ENGLISH summary
(Contract EURATOM-001-62-6 TEGI)
(EUR-3471-i)
A study was carried out on the design and fabrication of fuel elements of the type currently used in the Latina Power Plant. In particular, the study envisages the fabrication of elements containing rods of fuel made up of a ternary U–Mo–Nb and U–Mo–Zr alloy which has been subjected to special heat treatment. The entire work can be broken down into three quite distinct phases—rod fusion, heat treatments, and element assembly and cladding. Each of these operations in turn comprises a series of special processes which have necessitated the development of methods and equipment, in some cases appropriately designed, which are described in detail in the present final report. Author

N67-35138# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
THE DEVELOPMENT OF TEXTURE IN ZIRCONIUM ALLOY TUBES AND ITS EFFECT ON MECHANICAL PROPERTIES
E. A. Cheadle Mar. 1967 21 p refs
(AECL-2698) CFSTI: HC$3.00/MF$0.65
The development of texture in zirconium alloy tubes is described and rules formulated which allow the control of texture in the various fabrication processes. The mechanical properties of Zircaloy-2 fuel sheathing are shown to be affected by texture and a single preferred orientation with the principal hexagonal axes in the radial direction gives the best combination of strength and ductility.
Author

N67-35158# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
LOGARITHMIC INTEGRATOR AND PERIOD MEASUREMENT, RESPONSE VELOCITY AND STATISTICAL FLUCTUATION [INTEGRADOR LOGARITMICO Y MEDIDOR DE PERIODO VELOCIDAD DE RESPUESTA Y FLUCTUACION ESTADISTICA]
A. Battista and S. Pinasco 1967 36 p refs In SPANISH
(CNEA-181)
In application to continuous measurement of neutron flux during reactor startup, the period measurement on a logarithmic scale is investigated. Mathematical expressions are derived to illustrate concepts of: response velocity, diode valves, statistical fluctuation, amplifier, and differentiator. Design requirements are listed, and schematics depict the pertinent circuitry described.
Transl. by R.Ll.

N67-35173# Brookhaven National Lab., Upton, N. Y.
HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW Bimonthly Technical Progress Review
Feb. 1967 62 p refs *Its* Vol. 5, No. 1
(BNL-50048 (PR-25)) CFSTI: HC$3.00/MF$0.65
Research projects are reviewed under the headings of physical properties and thermodynamics, fluid dynamics, heat transfer materials development and corrosion and erosion, instrumentation, component development, systems studies, chemistry and chemical analysis, fabrication techniques, and safety related to high temperature liquid metal technology. Reviews for 20 current projects are included, and authors' comments on reviews presented in previous issues of this bimonthly technical progress review are presented as rebuttals. Organizations with reports in this and previous issues are listed, along with all of relevant review numbers.
M.W.R.

N67-35185 Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht (West Germany).
THE CALCULATION OF PLACE-DEPENDENT NEUTRON SPECTRA IN WATER–IRON–WATER SHIELDING ASSEMBLIES AND THE RELATIONS OF THE DIFFUSION APPROXIMATION FOR EXACT TRANSPORT THEORY IN HIGH-FLUX-GRADIENT AREAS
R. Fiebig Brussels, EURATOM, May 1967 121 p refs In GERMAN; ENGLISH summary
(Contract EURATOM-002-61-1 PNID)
(EUR-3472.d)
The pattern of the neutron spectra in a plane water–iron–water shielding assembly was calculated with a BINE neutron-transport program and from the results, group constants for a multi-group diffusion calculation were derived. In addition to the neutron-flux and flow pattern, the place-dependence of the group constants was studied and significant differences were recorded compared with the P1 approximation of the group constants obtained. The transport results were checked by means of group constants averaged according to areas, and the results are discussed.
Author

N67-35227# Atomics International, Canoga Park, Calif.
EVALUATION OF CROSS SECTIONS AND RESONANCE PARAMETERS FOR U-235, U-233, Pu-239, AND Pu-241 BETWEEN Cd-CUTOFF AND 10 keV
H. H. Hennies 25 May 1967 60 p refs
(Contract AT(04-3)-701)
(NAA-SR-11980, Vol. V) CFSTI: HC$3.00/MF$0.65
Fission and capture cross sections between Cd-cutoff and 10 keV were evaluated for the fissile isotopes, based on the available experimental differential cross sections, capture-to-fission ratios, and total fission and capture resonance integrals. Data available before December 1966 were considered. Several earlier evaluations such as the 1965 edition of BNL-325 were compared with more recent data. As a result of this evaluation, it is felt that even for the most intensively studied nucleus, U-235, the uncertainties in the fission cross section are about ±5%, and in the capture cross section ±20%. For Pu-239, σ_f is known to ±10% and σ_c to ±25%. For U-233 and Pu-241, the uncertainty in σ_f is ±15% and in σ_c ±30%. Different sets of resonance parameters for the resolved resonances, which are recommended in BNL-325 or by other research laboratories, were compared by calculating infinitely dilute total and partial resonance integrals. Calculations were performed with the resonance integral code TRIX-I, which is based on the single-level Breit–Wigner model. Average

parameters for the unresolved resonances were extrapolated from resolved resonance parameters. Calculated partial resonance integrals, using these parameters, were compared with integrated measured cross sections where these are available. If necessary, the resonance parameters were slightly modified to give a better representation of the cross sections. Since published capture cross-section measurements do not exist for the keV-resonance-region of U-233, Pu-239, and Pu-241, these cross sections were calculated with the determined average parameters and appropriate statistical distributions. Author (NSA)

N67-35231 Joint Publications Research Service, Washington, D. C.
CERTAIN PROBLEMS IN THE MATHEMATICAL THEORY OF THE CRITICAL STATE OF REACTORS
S. B. Shikhov 3 Aug. 1967 20 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 7, no. 1, Jan.–Feb. 1967 p 113–127
(JPRS-42067; TT-67-32697) CFSTI: $3.00

Formulations are presented for basic theorems and propositions related to the mathematical theory for nuclear reactors, including the thermal motion of nuclei in slow-breeding media. The theorems cited are considered, in many respects, to represent a case in which there is a relationship between the energy and the results obtained for a one-velocity problem. Following a presentation of the thermal motion specifics, the properties of the operators are studied in complex B-spaces and the full continuity of the operators is shown. Details are presented for the existence and uniqueness of a solution of the critical equation, and for the solution of the nonstationary equation. M.W.R.

N67-35245 Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Institut fuer Chemie.
THE USAGE OF OXIDIZING ACIDS FOR DISINTEGRATION OF FUEL INSERTS FOR GAS-COOLED HIGH TEMPERATURE REACTORS [DIE VERWENDUNG OXYDIERENDER SAEUREN ZUM ZERLEGEN VON BRENNSTOFFEINSAETZEN FUER GASGEKUEHLTE HOCHTEMPERATURREAKTOREN]
H. Bildstein, K. Knotik, P. Leichter, and H. Wagner 1967 19 p refs In GERMAN; ENGLISH summary Submitted for publication
(SGAE-CH-45/1967)

To investigate fuel inserts for high temperature reactors, a disintegration method was developed which permits a rapid and clean separation of the graphite bodies into coated particles and fine graphite powder. It is based upon an oxidative attack of graphite at grain boundaries and an enhancement of breakdown of the structure of gas evolution using $(NH_4)_2S_2O_8$ as oxidizing agent dissolved in H_2SO_4(96%). The penetration of sulfuric acid increases the speed of deconsolidation. Fuel inserts prepared by compacting mixtures of coated particles and graphite powder are completely disintegrated in 20 minutes; fuel elements with graphite shells require one hour. During the reaction no additional defects are created, thus permitting a determination of defects formed during fabrication or irradiation. Author

N67-35257# Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe.
RAW MATERIAL IN THE CONSTRUCTION OF THE MOSEL REACTORS [WERKSTOFFE IN DER KONSTRUKTION DES MOSEL-REAKTORS]
G. Metzger May 1967 56 p refs In GERMAN
(JUL-487-RW)

Structural materials are considered for extended periods of operation in liquid lead and molten fluoride salt at temperatures between 500° and 1000°C. Attention is focused on mechanical properties, forming, corrosion resistance, and scale resistance. The evaluation of candidate metals for alloying showed that nickel, iron, vanadium, niobium, molybdenum, and tantalum have the most promising properties. Steel and nickel alloys can be used only within the range from 500° to 1000°C, while the other metals will have to be used for higher temperatures. Niobium or niobium alloy proved to be the outstanding material for general structural application. Transl. by K.W.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N67-34125# Bausch and Lomb, Inc., Rochester, N. Y. Research and Development Div.
INFRARED COATING STUDIES Quarterly Report, 16 Mar.–15 Jun. 1967
R. L. Maier 15 Jun. 1967 17 p refs
(Contract DA-44-009-AMC-1707(E))
(QR-4; AD-653850) CFSTI: HC $3.00/MF $0.65

Research was carried out on coating materials for the far infrared. Films of TlBr and TlF were prepared and evaluated. Silicon and germanium were evaluated as substrate materials for the infrared to 40 microns. Measured curves of reflectance and transmittance are presented. The results of single layer anti-reflection coatings for these substrates are also given. Low frequency pass filters constructed and measured transmittance curves are presented. Two bandpass filter designs of the twin cavity all-dielectric type are also described. Maximum transmittance near 32 microns was obtained. TAB

N67-34171# Brookhaven National Lab., Upton, N. Y.
SEPARATED FUNCTION MAGNET LATTICE FOR A VERY HIGH ENERGY SYNCHROTRON
G. T. Danby, J. E. Allinger, and J. W. Jackson [1967] 27 p refs Presented at the 2d Intern. Conf. on Magnet Technol., Oxford
(BNL-11346; CONF-670705-2) CFSTI: HC $3.00/MF $0.65

The magnetic characteristics of a separated function magnet lattice are discussed and the problems raised by this design are investigated. NSA

N67-34252# Brookhaven National Lab., Upton, N. Y.
EFFECT OF INSULATION BETWEEN VACUUM CHAMBER SECTIONS ON RESISTIVE INSTABILITIES
E. D. Courant 19 Apr. 1967 4 p refs
(Contract AT(30-2)-GEN-16)
(BNL-11336) CFSTI: HC $3.00/MF $0.65

It was shown that the transverse resistive instability is the same when the vacuum chamber is sectioned off with capacitive flanges between sections as when the vacuum chamber is electrically continuous. The growth rate term V in the longitudinal instability is also unaffected; however, there is an effect on the threshold for this instability. Author (NSA)

N67-34266# Argonne National Lab., Ill.
EXCITATION OF FIRST AND SECOND SOUNDS IN He^3–He^4 SOLUTIONS [VOZBUZHDENIE PERVOGO I VTOROGO ZVUKOV V RASTVORAKH He^3–He^4]

E. Ya. Rudavskii and I. A. Serbin Mar. 1967 6 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 51, no. 6, 1966 p 1930–1933
(ANL-TRANS-455) CFSTI: HC $3.00/MF $0.65

The pressure, temperature, and concentration variation amplitudes are calculated for first and second sound waves in super-fluid solutions of helium isotopes. It is shown that a surface with a periodically varying temperature induces simultaneously in the solutions first and second sounds whose intensities may be of the same order of magnitude. Author (NSA)

N67-34290*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ACOUSTIC SPECTRUM SHAPING UTILIZING FINITE HYPERBOLIC HORN THEORY
Charles D. Hayes 15 Aug. 1967 33 p refs
(Contract NAS7-100)
(NASA-CR-87499; JPL-TR-32-1141) CFSTI: HC $3.00/MF $0.65 CSCL 20A

Described is the technique developed for shaping the sound spectrum of high intensity sound to achieve specialized response characteristics from single horns or multiple horn arrays. The design parameter analysis for the technique developed includes computations and computer simulation of horn responses using the hyperbolic horn theory. This technique provides the ability to minimize any undertesting or overtesting of the test article. Author

N67-34303* Houston Univ., Tex.
SCALAR AND VECTOR HELMHOLTZ INTEGRALS IN SCATTERING OF PLANE WAVES BY ONE-DIMENSIONAL ROUGH SURFACES
H. S. Hayre and C. Kopala 1967 9 p refs
(Contract NAS9-6760)
(NASA-CR-65669) CSCL 20N

Scalar and vector forms of Helmholtz integral formulations of scattering of plane waves by one-dimensional rough surfaces are presented and compared. The results show that scalar form yields exact results for horizontally (perpendicular) polarized incident wave, whereas it does not seem to be adequate for vertically (parallel) polarized incident wave with field component normal to the local surface. Author

N67-34374*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CONTACT DIFFUSION INTERACTION OF MATERIALS WITH CLADDING
Redstone Arsenal, Ala., Redstone Sci. Inform. Center, 19 May 1967 42 p refs Transl. into ENGLISH from Proc. of the Symp. on Thermodyn. with Emphasis on Nucl. Mater. and Atomic Transport in Solids, v. 2, 1966 p 153–180 Symp. held in Vienna, 22–27 Jul. 1965 Jointly supported by Army Missile Command
(NASA-TM-X-60158; RSIC-676) CFSTI: HC $3.00/MF $0.65 CSCL 18J

CONTENTS:

1. CHARACTERISTICS OF DIFFUSION PROCESSES IN CONDENSATES, FORMED ON A HOT CLADDING A. A. Babad-Zakhryapina and L. Gert p 1–11 refs (See N67-34375 20-23)

2. DIFFUSION OF CARBON FROM CARBIDE OF URANIUM INTO MOLYBDENUM AND TUNGSTEN V. S. Eremeyelev, A. S. Panov, B. F. Ushakov, and Ye. V. Fivelskii p 11–24 refs (See N67-34376 20-17)

3. RESEARCH INTO THE DIFFUSION OF CARBON INTO ZIRCONIUM AND ZIRCONIUM CARBIDE R. A. Andrievskii, V. N. Zagryazkin, and G. Ya. Meshcheryakov p 25–35 refs (See N67-34377 20-17)

N67-34375*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CHARACTERISTICS OF DIFFUSION PROCESSES IN CONDENSATES, FORMED ON A HOT CLADDING
A. A. Babad-Zakhryapina and L. Gert *In its* Contact Diffusion Interaction of Mater. with Cladding 19 May 1967 p 1–11 refs (See N67-34374 20-23)

Diffusion processes, and the interaction of the condensate with the cladding are reported. A characteristic of the first stage of diffusion interaction of film with materials is the simultaneousness of the course of the two processes: condensation and diffusional transfer of the cladding material into a growing layer. The continuity of the condensate growth, as well as the law governing the growth of the layer itself, gives rise to the appearance of certain specific characteristics in the character of diffusion interaction. These are briefly discussed. R.U.

N67-34385# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton. Electrostatic Generator Group.
AN EXPERIMENTAL ANALYSIS OF 90° UNIFORM FIELD BEAM BENDING MAGNETS FOR USE WITH ELECTROSTATIC GENERATORS
W. R. Morris Sep. 1966 40 p refs
(RHEL/R-119) CFSTI: HC $3.00/MF $0.65

An experimental analysis of two 90° uniform field beam bending magnets using field measuring techniques and defined beams of alpha particles is described. The role of these magnets now in use with the Oxford Nuclear Structure Project is discussed and the theory of focusing is outlined. A brief description of the design of each magnet is included. The test arrangements and analytical methods employed in conducting the magnetic field surveys and alpha particle ray tracing are detailed. The results obtained are listed and compared with the theoretical values and the reasons for any differences in the results discussed. Author (NSA)

N67-34392# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
MODEL FOR PREDICTION OF JET NOISE FROM MEASUREMENTS OF FLUCTUATION TURBULENT STRESSES
Ian S. F. Jones Apr. 1967 42 p refs
(RR-5) CFSTI: HC $3.00/MF $0.65

An analysis is presented which allows the details of the far field acoustic radiation from a subsonic jet to be predicted from measurements of fluctuating turbulent stresses. Starting from Lighthill's theory of convected quadrupole radiation, the solution is rewritten in terms of Fourier components in time and space. With this formulation the problem of evaluating the acoustic radiation is reduced to one of determining in a fixed frame the intensity of the fluctuating Reynolds stresses, their spectra and the eddy volume of each Fourier component. In order to simplify the experimental information required, the self-preserving nature of the flow in a jet is exploited, and in a compromise between a complete model and an experimentally realizable model, all the pertinent stress intensities are retained. The spectra and eddy volumes of temporal Fourier components of all quadrupoles are estimated from this information for only one normal stress. The eddy volumes are, in turn, estimated from frequency dependent length scales along three axes. Author

N67-34544# Pittsburgh Univ., Pa.
RESEARCH ON SOLUTIONS OF THE GRAVITATIONAL FIELD EQUATIONS Final Technical Report
Ezra T. Newman and Allen I. Janis Wright-Patterson AFB, Ohio. ARL, Mar. 1967 144 p refs
(Contract AF 33(615)-1523)
(ARL-67-0053; AD-653581) CFSTI: HC $3.00/MF $0.65

The work is primarily concerned with gravitational radiation problems and related phenomena. The work can be broadly classified into two main categories with several subclasses: (i) exact solutions of the Einstein field equations and their properties, (ii) asymptotic behavior of solutions, (a) asymptotic structure, e.g. multipole moments, (b) scattering of gravitational radiation, (c) asymptotic symmetries, i.e. the Bondi–Metzner–Sachs group, (d) conservation laws, and in particular those recently discovered by Newman and Penrose. TAB

N67-34609# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOURNAL OF PHYSICS
20 Dec. 1966 71 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 21, no. 5, 1965 p 15–37 and 1061–1074 (FTD-HT-66-531; TT-67-62106; AD-653531) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. THE TRANSVERSE MAGNETORESISTANCE OF n-TYPE GERMANIUM IN A STRONG MAGNETIC FIELD S.-f. Lan p 1–36 refs (See N67-34610 20-26)

2. ULTRANSONIC ABSORPTION IN AQUEOUS SUSPENSIONS Y.-c. Wei and S.-i. Chang p 37–64 refs (See N67-34611 20-23)

N67-34611# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ULTRASONIC ABSORPTION IN AQUEOUS SUSPENSIONS
Yung-Chio Wei and Sue-i Chang *In its* J. of Phys. 20 Dec. 1966 p 37–64 refs (See N67-34609 20-23)

The ultrasonic absorption in aqueous suspensions (essentially at low concentrations) has been investigated by the pulse interferometric technique. Epstein's theory on this effect is briefly reviewed with the general expressions as well as those of limiting cases for calculating sound attenuation coefficients are derived and discussed corresponding to the actual experimental conditions. Measurements were conducted in aqueous suspensions of the pollen of pinaceae in the frequency range from 3 to 30 Mc at temperatures 20–80°C for different concentrations. Theoretical values based on rigorous formulae and calculated by aid of electronic digital computer were compared with the experimental ones. Measuring data and corresponding theoretical interpretations based on approximate formulae from some other authors for aqueous suspensions of lycopodium were critically examined. It was pointed out that some of their agreement was fortuitous. The order of magnitude of absorption due to viscosity and scattering under different experimental conditions for the two suspensions was discussed in some length. Author

N67-34646# Marine Engineering Lab., Annapolis, Md.
DEGAUSSING COIL INTERFERENCE
C. C. Fennell, D. M. Peoples, and L. T. Dunnington Mar. 1967 35 p refs
(MEL-297/66; AD-653450) CFSTI: HC $3.00/MF $0.65

Because of their ferromagnetic properties, steel-hulled ships distort the ordinarily uniform earths magnetic field. To avoid detection by magnetically-triggered mines, naval vessels have installed degaussing coils to generate magnetic fields opposing this distortion. The degaussing coils are arranged to compensate for the ships influence and restore a relatively uniform field some distance beneath the water surface. Certain shipboard instrumentation can be seriously affected by these degaussing coil fields. To alleviate this problem, shipboard locations exhibiting low degaussing coil field strengths should be predetermined to ensure a safe environment for such sensitive instruments. Initially the degaussing coil system was simulated by a digital computer for the purpose of computing system magnetic field values for the air-core case (excluding effects of ferromagnetic material). A least mean square method was used to ascertain the degree to which air-core data could be used to predict the actual shipboard values. Results of this analysis indicate that shipboard magnetic fields cannot be predicted to any useful degree of accuracy by means of simple proportionality with the air-core data. Author (TAB)

N67-34716 Electrotechnical Lab., Tokyo (Japan).
SIMULTANEOUS WIENER–HOPF EQUATIONS AND THEIR APPLICATION TO SOME BOUNDARY VALUE PROBLEMS IN ELECTROMAGNETIC THEORY
Akira Igarashi Dec. 1966 71 p refs In JAPANESE; ENGLISH summary *Its* Electrotech. Lab. No. 668

Simultaneous Wiener–Hopf equations with the kernel, which has special properties, and their application to some boundary value problems in electromagnetic theory are discussed. If the kernel of the simultaneous Wiener–Hopf equations is an $n \times n$ symmetric Jacobi matrix with parameters and can be made into a normal matrix in the whole of the complex plane by choosing their parameters appropriately, it is proved that there exists a constant matrix such that it transforms the kernel into a diagonal form. In this case, therefore, the factorization of the kernel is obtained by the same method as for a single equation of the Wiener–Hopf type. On the basis of this result, a treatment is made of the problem of a duct with n semi-infinite parallel plates; that is, as it is shown that the above-mentioned problem of a duct is reduced to finding the solution of the simultaneous Wiener–Hopf equations with the kernel which is a symmetric Jacobi matrix involving the distance between two semi-infinite parallel plates as the parameters and its kernel becomes a normal matrix by choosing these parameters appropriately, a rigorous and explicit solution is obtained by an elementary method. In a certain problem involving Laplace's equation in two-dimensional polar coordinates, as the kernel can be made into the function of a cyclic matrix by choosing parameters appropriately and transformed into a diagonal form, the same method of factorizing the kernel is applicable. Author

N67-34750°# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SELF-STEEPENING OF LIGHT PULSES
F. De Martini, C. H. Townes, T. K. Gustafson, and P. L. Kelley [1967] 57 p refs
(Grant NsG-330; Contract DA-28-043-AMC-02536(E))
(NASA-CR-87476) CFSTI: HC $3.00/MF $0.65 CSCL 20F

The self-steepening, or change in shape, of light pulses due to propagation in a medium with an intensity-dependent index of refraction is investigated. The time required for the pulse to steepen into an optical shock is found, and the time development of the pulses is studied for both zero and finite times of relaxation of the index of refraction. Analytic and numerical solutions are given for the pulse development in a number of cases. The frequency spectrum is obtained in the zero relaxation time limit and the largest peak intensities are found on the lower frequency side of the input spectrum. Although the rate of steepening is modified when the decay time of the pulse becomes as short as the relaxation time for the nonlinear part of the index of refraction, the time of decay can become arbitrarily short when there is no dispersion. Estimates are given of the thickness of the optical shock region and of the frequency spreading allowed by dispersion with the effect of relaxation included. The influence of self-steepening or pulse distortion in nonlinear optical experiments is discussed. Author

N67-34794# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
PHYSICAL QUANTITIES AND NATURAL LAWS [GRANDEZZE FISICHE E LEGGI NATURALI]

M. Ageno 10 Apr. 1967 67 p In ITALIAN; ENGLISH summary Presented at a Conf. held in Milan, 10 Apr. 1967; Sponsored by the Min. of Public Instruction
(ISS-67/10) CFSTI: HC $3.00/MF $0.65

Observations on the logical structure of physics are presented as a conference paper delivered during the conference held April 10, 1967, at the Leonardo da Vinci National Museum of Science and Technology, in Milan, Italy. The importance of geometry is stressed in relation to physical quantities and natural laws. Themes expanded during the conference were on: logical systematization of physics, concepts of modern usage, operative definitions, and the origin and nature of physical laws. Transl. by R.L.

N67-34818# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 3, NO. 6 Monthly Review of Selected Foreign Scientific and Technical Literature
Jun. 1967 60 p refs

A review is made of Soviet literature on the rare earth element chelates for liquid laser application. Surveys are presented on helium production in the U.S.S.R., investigations in the field of low temperature physics, the function of the Soviet State Committee for Science and Technology, and a profile of the research worker in Hungary. Brief technical notes are included on field rotation noise in magnetic thin films, high intensity molecular gas lasers, Soviet short range radio forecasting service, and the development and present state of seismological investigations and seismological service in Hungary. The proceedings of conferences on the physics of cosmic rays, the physics and technology of high and ultrahigh vacuum, seismology, and the permanent geomagnetic field and paleomagnetism are summarized. R.N.A.

N67-34840# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
STUDY OF UNDERWATER LOW FREQUENCY ELECTROMAGNETIC PROPAGATION
A. Morganstern and A. Crews Aug. 1967 35 p refs
(RE-298)

Results of analytical studies and field tests of a new phenomenon (hydronic radiation) in underwater communication which allows reception at long ranges using low power are reported. Quantitative measurements were made at frequencies of 83, 750, and 4900 cps, and results were compared with predictions using classical theory. Experimental results were in agreement with theoretical predictions; however, scientific results did not support claims of a new discovery. These studies further indicated that secure underwater communication by low frequency electromagnetic means is limited to short ranges with there being no recognizable advantages over existing means, such as acoustics. Although claims and results seemed to give rise to some interesting applications because of the use of very simple dipoles and simple electronic equipment operating in a frequency band not normally utilized for electromagnetic propagation, it is indicated that the proposed claims are basically consistent with classical theory of underwater electromagnetic propagation. On the basis of these findings, no further study of electromagnetic propagation for these applications is recommended. S.C.W.

N67-34885 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
GROUND-STATE OF SOLID HELIUM 4 AND 3
Jean-Pierre Hansen and Dominique Levesque Jun. 1967 26 p refs
(TH-205)

A variational calculation of the ground state energy versus density curve for solid helium 3 and solid helium 4 at absolute zero is presented using a two-parameter "localized" Jastrow × gaussian trial wave function. The energy expectation value is calculated by a Monte Carlo method taking advantage of the formal analogy between the quantum variational problem integral and a classical canonical ensemble configuration integral. Results are in good agreement with experiment. The solid–liquid phase transition for both He_3 and He_4 is predicted to take place at densities close to the experimental ones. The Monte Carlo method has also been used to test the validity of a variational calculation on a truncated cluster expansion of the energy expectation value due to Nosanow. Author

N67-34902 Tasmania Univ., Hobart (Australia).
A REFLECTION TECHNIQUE FOR THE SURVEY OF THE DEFLECTION OF FLAT PLATES
Eric Middleton Dec. 1965 18 p refs

An optical technique based on transparent diffraction gratings is described by which the deflection contours of deformed nearly flat plates may be obtained to any required sensitivity between 0.000 05 in. and 0.010 in. The theory of diffraction gratings in reflection arrangements is given and the optical requirements to eliminate perspective distortion are outlined. Experimental verification using diffraction gratings containing 1,000 lines per inch to give a deflection sensitivity of 0.000 81 in. fringe shows the method to be reliable. Author

N67-34913# Navy Underwater Sound Lab., New London, Conn.
THE ACOUSTIC FIELD IN A CLOSED SPACE BEHIND A RECTANGULAR SIMPLY SUPPORTED PLATE EXCITED BY BOUNDARY LAYER TURBULENCE
Wayne A. Strawderman 11 May 1967 158 p refs
(USL-827; AD-653455) CFSTI: HC $3.00/MF $0.65

An analytic solution is obtained for the acoustic pressure statistics in a closed rectangular shaped cavity behind a simply supported, rectangular plate excited by boundary layer turbulence. The contribution of the cavity acoustic pressure is neglected as contributing to the plate excitation, leaving only the turbulent pressure fluctuations as the exciting force. The mathematical model for the turbulent pressure statistics is based on that of Corcos, which agrees well with experiment. A byproduct of this analysis is an analytic solution for the turbulent flow excited plate vibration velocity statistics. The plate velocity and cavity acoustic pressure statistics are expressed in the form of cross power spectral densities and power spectral densities. Dimensionless forms of the plate velocity spectral density and cavity acoustic pressure spectral density are developed. The dimensionless plate velocity spectral density and dimensionless cavity acoustic pressure spectral density were computed, by means of a digital computer, for selected values of dimensionless input parameters. From these computed dimensionless spectra, the effects of major parameters on the plate velocity spectral density and the cavity acoustic pressure spectral density were determined. Author (TAB)

N67-38120# Sandia Corp., Albuquerque, N. Mex.
ANALYSIS OF THE DESPINNING OF A PRECESSING AND NUTATING RIGID BODY
Farrell J. Perdreauville Apr. 1967 32 p refs
(Contract AT(29-1)-789)
(SC-TM-67-214) CFSTI: HC $3.00/MF $0.65

If a spin-stabilized body is coning at the instant that despin action begins, it becomes necessary to determine whether the despin mechanism will perform in the same manner as it would were the body not coning and what the motion of the body will be after the despin mechanism has functioned. An analysis of flyweight-despin of a coning body and of the motion of the body after the flyweight mechanism has spent itself is described. Author (NSA)

N67-35129*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
POWER SPECTRAL DENSITY ANALYSIS
Charles D. Hayes 15 Mar. 1967 14 p Revision 1
(Contract NAS7-100)
(NASA-CR-87804; JPL-TR-32-928, Rev. 1) CFSTI: HC $3.00/MF $0.65 CSCL 20A

Generalized techniques for determining the equation describing the power spectral density function (G^2/cps versus frequency, etc.) and the equation for determining the root mean square of a power spectral density function are developed. Examples of both types of equations are included. Author

N67-35162# Institut Franco-Allemand de Recherches, St. Louis (France).
STUDY ABOUT THE GEOMETRICAL AND CHRONOLOGICAL DISTRIBUTION OF LIGHT EMISSION THROUGH A VACUUM FILTER [ETUDE SUR LA REPARTITION DANS L'ESPACE ET DANS LE TEMPS DE LA LUMIERE EMISE LORS D'UNE DECHARGE ELECTRIQUE DANS LE VIDE]
F. Jamet 26 Apr. 1966 19 p refs In FRENCH
(ISL-T-8/66)

Consideration is given to the experimental results of a study concerning the electric discharge between two electrodes in a vacuum. The geometric and chronological distribution of light emitted in the spark gap was recorded by a photographic camera. The time gap separating two images varies from 50 to 100 ns. The hypothesis is confirmed that an anode vapor plays an essential role in the formation of the arc. Transl. by R.Li.

N67-35179# Gt. Brit. Ministry of Aviation, London. Aeronautical Research Council.
THE RADIATION SOUND FIELD OF A RECTANGULAR PANEL SET IN AN INFINITE WALL AND EXCITED BY A TURBULENT BOUNDARY LAYER
D. E. Davies HMSO, 1967 36 p refs Supersedes RAE-TN-STRUCT-355; ARC-26151; see X64-16606
(ARC-R&M-3491; RAE-TN-STRUCT-355; ARC-26151) CFSTI: HC $3.00/MF $0.65

A flexible panel, set in an infinite wall, is subject to an excitation force distribution which can be described by a correlation function. The panel vibrates and radiates sound. Expressions are derived for the intensity and pressure power spectrum in the sound field at points which are far away from the panel in comparison with the superficial dimensions of the panel. If the excitation of the panel is due to the flow, over one of its faces, of a turbulent boundary layer, the thickness of which is small in comparison with the superficial dimensions of the panel, then an approximate expression for the correlation function of the excitation force distribution can be used in the evaluation of the expressions obtained. This evaluation has been made to determine the intensity and pressure power spectrum at points on or near to the normal through the center of the undisturbed panel and on the other side of the panel from the one containing the boundary-layer flow. In this way we can determine the way in which the intensity and pressure power spectrum at these points depends on the plate dimensions and material properties, on the speed of the flow containing the boundary layer, on the thickness of the boundary layer and on the density of and speed of sound in the fluid medium around the panel. Author

N67-35184# Institut Franco-Allemand de Recherches, St. Louis (France).
MEASUREMENT OF THE IONIZATION BEHIND HIGH VELOCITY PROJECTILES USING A CAVITY RESONATOR AND A HYPERFREQUENCY INTERFEROMETER [MESURE DE L'IONISATION DERRIERE DES PROJECTILES A GRAND VITESSE, A L'AIDE D'UNE CAVITE RESONNANTE ET D'UN INTERFEROMETRE]
M. Laug 4 Oct. 1965 36 p refs In FRENCH
(Contract SEREB-31-07)
(ISL-T-31/65) CFSTI: HC $3.00/MF $0.65

A free flying projectile in an hyperballistic flight tunnel passes successively through a 4 mm microwave bundle and a 250 mHz cavity resonator. Damping and phase shift of the wave are determined interferometrically at the first measuring point. The other measuring point gives initial admittance into the cavity in real and in imaginary sections. Each of both methods produce two characteristic plasma values. Their advantages and disadvantages are discussed. Concurrent application of both methods can produce three more plasma parameters in some cases (the two-times measured shock value, the electron density, and the plasma diameter). The cavity is filled by a dielectric. Author

N67-35270# General Electric Co., Schenectady, N. Y. Research and Development Center.
CONDUCTION PROCESSES IN DIELECTRIC FLUIDS, II
Charles Muckenfuss Nov. 1966 56 p refs
(Rept.-66-C-422)

The role of diffusion in the conduction process in fluids of low conductivity is studied. A set of constraints on certain parameters that appear in the analysis are derived. From them the space-charge-limited conduction law is rederived and used to derive formulas for the volume charge density and effective conductivity at the interface in the SCL mode. These depend on the two-thirds power of the current density and material parameters and are independent of the extent of the material. Various properties of the charge density, electric field, body force, and potential profiles in the material are discussed. The problem is considered with conditions besides those necessary for SCL conduction. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N67-34051# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.
FIRST-ORDER WKBJ INTEGRALS FOR LENNARD-JONES (12,6) AND EXPONENTIAL (α,6) POTENTIALS
Halstead Harrison May 1967 17 p ref
(DI-82-0617; AD-653948) CFSTI: HC $3.00/MF $0.65

Tables are presented which permit interpolation to give eigenenergies of diatomic molecules with Lennard-Jones (12,6) or exponential (alpha,6) interatomic potentials. Author (TAB)

N67-34092# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
FIRST ADDENDUM TO THE DATA HANDBOOK FOR SENSITIVITY CALCULATIONS IN NEUTRON ACTIVATION ANALYSIS
F. Girardi, G. Guzzi, and J. Pauly 1966 28 p refs
(EUR-1898.e, Addend. I) CFSTI: HC $3.00/MF $0.65

This addendum covers three analyses which are done by secondary reactions with triton particles. They can easily be obtained with thermal neutrons and were therefore included. The reaction $Bi^{209}(n, \gamma)Bi^{210}$ has also been added as analytically significant. Nine sensitivity sheets for short-lived isotopes are included to be substituted to the existing sheets. The sensitivity data have been

modified to take into account the decay of the isotope during the counting. A counting time of two half-lives has been used, instead of the previously adopted ten minutes, for isotopes with half-lives shorter than five minutes, in order to obtain a higher sensitivity. Author

N67-34097# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

THE MEASUREMENT OF CHARGE TRANSFER CROSS SECTIONS FOR HIGH ENERGY (≈ 1 MeV) PROTONS AND HYDROGEN ATOMS INCIDENT UPON HYDROGEN AND HELIUM GASES

J. F. Williams Sep. 1966 29 p refs
(AAEC/E159) CFSTI: HC$3.00/MF$0.65

Measurements of the single and double electron capture cross sections for protons, σ_{10} and σ_{1-1} respectively, and the single electron loss cross section for hydrogen atoms, σ_{01} within the energy range 0.25 to 2.5 MeV for hydrogen and helium target gases are reported and compared with published theoretical estimates and experimental values. The present values of σ_{10} and σ_{01} agree well with the data of Barnett and Reynolds below 1 MeV. The extrapolation of the data of Barnett and Reynolds to pass through the single value at 10 MeV by Berkner is confirmed. The experimental values of σ_{01} agree with calculations that use the Born and free-collision approximations within the experimental uncertainty of ±10%. The values of σ_{1-1} decrease from 5.1×10^{-25} cm^2/mol at 0.4 MeV to 1.6×10^{-28} cm^2/mol at 1.0 MeV with an experimental uncertainty of up to a maximum of 60%. These values are lower than, but exhibit a similar dependence upon proton energy to the first Born approximation calculations by Mittleman. A detailed discussion is given of the experimental accuracy which was based upon a procedure previously devised by the author. Author

N67-34115# Naval Civil Engineering Lab., Port Hueneme, Calif.

A CRITICAL EVALUATION OF THE MARKOV MATRIX TREATMENT OF NEUTRON DIFFUSION IN SLABS

M. L. Eaton and C. M. Huddleston May 1967 52 p refs
(R-529; AD-653444) CFSTI: HC$3.00/MF$0.65

It is known that a method based on the concept of a Markov chain can be used to treat the problem of absorption, transmission, and backscatter when single-velocity neutrons are incident on a plane slab of finite thickness, under the assumption that scattering is isotropic in the laboratory system (see AD-640 260). Such conditions can exist when neutrons impinge on a slab of material, such as a shield or an inside wall of a shelter entranceway. Since the Markov matrix method is a new approach to the problem, the practical limits in applying the method have not previously been explored. This report outlines the region of usefulness of the matrix method. The solutions to some sample problems are given. Comparisons are made with other theoretical treatments. It is concluded that the Markov matrix method is useful over a wide region of interest. Within its limits of practical applicability, the method gives highly exact answers without requiring exorbitant computing time. Author (TAB)

N67-34173# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

SUM RULES IN THE GEMINAL EXPANSION OF MANY-ELECTRON WAVEFUNCTIONS

R. J. C. Brown Apr. 1967 6 p refs
(AAEC/TM382) CFSTI: HC$3.00/MF$0.65

An interpretation of certain sum rules in the method of Bopp is given in terms of the irreducible representations of the rotation group. It is accompanied by a simple numerical table, from which the sum rules may be obtained by inspection. Author

N67-34174 Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

DIFF, A CODE TO PREPARE NEUTRON DIFFUSION THEORY PARAMETERS FROM THE RESULTS OF THE CODE WDSN

N. Spinks and G. Manning Mar. 1967 27 p refs
(AAEC/E174)

With a solution of the multigroup neutron transport equation available for a problem in one dimensional geometry, diffusion theory parameters are determined so as to reproduce in diffusion theory the essential characteristics of the transport solution. Calculation of a more realistic reactor configuration can then be attempted in diffusion theory. Diffusion coefficients, taken as constant within a uniform region, can be determined so that the diffusion flux is an optimum fit to the transport flux. As an option the conventional $1/3\Sigma$ can be used. The homogeneous boundary condition is found from a diffusion theory calculation which uses the transport net current as an inhomogeneous boundary condition. The homogeneous boundary condition forces the diffusion theory to reproduce exactly the transport leakage and multiplication constant. A discontinuity in the diffusion flux is permitted at interfaces between different materials. Interface conditions, if applied, guarantee that any reaction rate, integrated over the volume of a uniform region, is preserved by the diffusion theory. The DIFF code uses the results of the WDSN transport code to calculate diffusion theory parameters for the CRAM diffusion code. Author

N67-34205# Kernforschungsanlage, Juelich (West Germany). Institut fuer Neutronenphysik.

INSTITUTE FOR NEUTRON PHYSICS Annual Report, 1966 [JAHRESBERICHT 1966 DES INSTITUTS FUER NEUTRONENPHYSIK]

Mar. 1967 50 p refs In GERMAN
(JUL-463-NP)

Experiments were conducted on neutron spectrometers, on a focusing small-angle scattering apparatus, and with a mass separator. Brief summaries are given of experiments conducted in: (1) solid state physics, with emphasis on scattering measurements; (2) applied and theoretical neutron physics, emphasizing nuclear spectroscopy and the fission process of U^{235}; and (3) plans for a mass separator for fission products, and design of a multiple neutron conductor to be used on the cold source of a high-flux reactor. Detailed illustrations and graphs are part of this report, and a list of published works is included. Transl. by K.W.

N67-34209 Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

ELECTRON IMPACT IONIZATION CROSS-SECTIONS AND IONIZATION RATE COEFFICIENTS FOR ATOMS AND IONS FROM HYDROGEN TO CALCIUM

Wolfgang Lotz May 1967 68 p refs
(IPP-1/82)

Using the empirical formula recently proposed, electron impact ionization cross sections for single ionization from the ground state are given for free atoms and for all ionization stages from hydrogen to calcium (Z=20). For these species ionization rate coefficients are given under the assumption of a Maxwellian distribution of the impacting electrons. Lowering of ionization potential, collision limit, or multiple ionization are not taken into account. Author

N67-34246# United Aircraft Corp., East Hartford, Conn.

SCATTERING OF THERMAL ENERGY GAS BEAMS BY METALLIC SURFACES II

John J. Hinchen, Evelyn S. Malloy, and James B. Carroll Jun. 1967 99 p refs
(Contract NOw-66-0228-d)
(F910439-7; AD-653720) CFSTI: HC$3.00/MF$0.65

Scattering of molecular gases from platinum and tantalum was studied using an ultra-high vacuum molecular beam apparatus. Beams of the rare gases, nitrogen, oxygen, methane and water vapor were used. The angle of maximum intensity of the scattered gas beams had a dependency on experimental variables that was in fair agreement with theory. Surface contamination and roughness affected the intensity and spatial distribution of scattered beams, but no difference between polycrystalline and single crystal metal surfaces was observed. By using phase-sensitive-detection techniques, the velocity of scattered molecules was found to vary with angular position about the surface. Energy and momentum coefficients were evaluated from the experimental data. Under certain conditions, discontinuities and negative values were found for these coefficients; such excursions in energy accommodation have been theoretically predicted. The experimental results were used in analysis of free molecule and slip flows. Author (TAB)

N67-34254# Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Forschungsreaktoren.

RIGID, SOLUTION OF THE ENERGY INDEPENDENT NEUTRON TRANSPORT EQUATION FOR A THIN IMBEDDED LAYER [STRENGE LOESUNG DER ENERGIE-UNABHAENGIGEN NEUTRONENTRANSPORTGLEICHUNG FUER EINE DUENNE EINGEBETTETE SCHICHT]

G. Meister May 1967 48 p refs In GERMAN
(JUL-484-RE) CFSTI: HC $3.00/MF $0.65

Theoretically examined is the problem of neutron distribution in a medium whose dimensions are small compared with the mean free path of the neutrons. A thin homogeneous layer is considered which is embedded in an infinitely extended medium with different transport properties. Assuming isotropic scattering, the energy-independent solenoidal neutron transport equation is solved for this case, and the formulas are derived for spatial distribution of neutron flux density and net neutron flow. The analytical eigenfunction method developed by K.M. Case is used. Transl. by K.W.

N67-34277# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

COMPARISON OF RESONANCE ABSORPTION THEORY USED IN THE CODES GYMEA AND PEAS AND EVALUATION OF RESIDUAL BACKGROUND REACTION RATES

J. L. Cook and A. L. Wall Dec. 1966 42 p refs
(AAEC/TM362)

Details of the resonance theory used in the code GYMEA are described and compared with exact solutions for resonances in Th232, U235, and Pu240. The relative merits of two methods for including background cross sections are evaluated, by an exhaustive study of the reaction rates across the resonances. It was found that the analytical procedure for calculating resonance reaction rates leads to tolerable errors in reactor physics calculations. The resonance adjusted calculations emerged as the most accurate method for computing the fine structure of the reaction rates across a resonance. Author

N67-34299*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

SEARCH FOR COSMIC GAMMA RADIATION WITH A VIDICON SPARK CHAMBER Final Report

G. G. Fazio, H. F. Helmken, S. J. Cavrak, Jr., and D. R. Hearn (Harvard Univ., Cambridge, Mass.) [1967] 15 p refs Presented at the 10th Intern. Conf. on Cosmic Rays, Calgary, Canada, 19 Jun. 1967
(Contract NSR-09-015-022)
(NASA-CR-87420) CFSTI: HC $3.00/MF $0.65 CSCL 20H

A vidicon spark chamber, flown in a high-altitude balloon has been used to search for primary gamma radiation (E>100 MeV). No celestial gamma-ray source was detected. The new upper limit to the flux from the Crab Nebula was found to be 3.1×10^{-5} cm^{-2} s^{-1}. The flux from the quiet sun was found to be $\leq 7.4\times10^{-5}$ cm^{-2} s^{-1}. A solar flare (type 2) also occurred during the flight. The flux was $\leq 6\times10^{-3}$ cm^{-2} s^{-1}, which is also a new upper limit. The gamma-ray background flux and energy spectrum at 4 g cm^{-2} altitude were measured. Author

N67-34311# Puerto Rico Nuclear Center, Mayaguez.

NEUTRON DIFFRACTION PROGRAM Progress Summary Report

M. I. Kay, S. F. Kaplan, R. Kleinberg, H. L. Ritter, I. Almodovar et al Apr. 1967 47 p refs
(Contract AT(40-1)-1833)
(PRNC-94; PSR-5)

Developments in the use of neutron diffraction for studies on chemical binding of atoms in crystals and molecules and the nature of ferromagnetism are reported. The compounds studied include manganese formate dihydrate, copper formate dihydrate, anhydrous copper formate, alums, and nickel and cobalt chloride hexahydrates. Ferroelectric and liquid structures are also discussed. NSA

N67-34312# California Univ., Berkeley. Lawrence Radiation Lab.

ON THE EQUAL MASS SPACING OF THE DECUPLET OF $J^P=3/2^+$ BARYONS

Richard Cyril Slansky (Ph.D. Thesis) 15 Mar. 1967 127 p refs
(Contract W-7405-ENG-48)
(UCRL-17450) CFSTI: HC $3.00/MF $0.65

With the assumption that the unperturbed amplitude is known in the ND^{-1} representation, equations are derived for calculating the perturbed amplitude as a function of the variations of the left-hand singularities and the unitarity cuts. Exact formulas for mass and coupling-constant shifts of bound states of the unperturbed amplitude are given, and the equations are then iterated to yield a perturbation theory. The response of the decuplet masses to octet perturbations of the meson and baryon masses and couplings is studied in an ND^{-1} model of baryon-meson scattering, and it is found that the equal mass spacing of the decuplet is satisfied, even for large values of the symmetry breaking. The numerical inaccuracy of several forms of perturbation theory indicates that the physical baryon masses represent a large symmetry breaking in the calculation of the decuplet; so large that first- and second-order perturbation theories do not explain the equal mass spacing of the decuplet, although experiment and the exact solution to the model do give equal spacing. The rapid breakdown of the octet sum rules for the S-matrix elements also suggests that the SU(3) violations are large, and that the octet output is special to the masses. Author (NSA)

N67-34315# Oak Ridge National Lab., Tenn.

ASPECTS OF AN EXPERIMENT FOR THE INVESTIGATION OF THE PHOTOPRODUCTION OF HIGHLY INTERACTING PARTICLES WITH ABSORPTION OF 5-6 GeV BREMSSTRAHLUNG IN A THICK TARGET

K. Heinze [1965] 12 p refs Transl. into ENGLISH of Tech. Hochschule Hannover Rept.-ABS-THH-1030
(ORNL-TR-1534; ABS-THH-1030) CFSTI: HC $3.00/MF $0.65

An experiment was performed with 5 to 6 GeV incident bremsstrahlung on thick copper and lead targets to study the production of highly interacting particles such as neutrons, protons, and pions. A brief discussion of the expected results is presented. NSA

N67-34330# Comitato Nazionale Per l'Energia Nucleare, Frascati (Italy).

INELASTIC SUM RULES FOR ELECTROMAGNETIC PROCESSES ON NUCLEAR TARGETS

A. Malecki 11 May 1967 10 p refs
(LNF-67/34) CFSTI: HC$3.00/MF$0.65

A formalism for the description of the electrodynamic processes with nuclear targets in the one photon exchange approximation is presented. The cross-section formulae for light nuclei, correct through order $1/M^2$(M–nucleon mass), are derived. The inelastic sum rule contains no weighing factors and can be compared with the experimental sums constructed with varying as well as at constant momentum transfer. High energy electron scattering and electron pair photoproduction are discussed as examples. Author

N67-34351# California Univ., Berkeley. Lawrence Radiation Lab.
POLE-ZERO ANALYSIS OF DISTRIBUTED RADIO-FREQUENCY ACCELERATION SYSTEMS
J. E. Katz and O. A. Kerns 14 Mar. 1967 5 p refs Presented at the Natl. Particle Accelerator Conf., Washington, D. C., 1–3 Mar. 1967 Submitted for publication
(Contract W-7405-ENG-48)
(UCRL-17448; CONF-670307-41) CFSTI: HC$3.00/MF$0.65

It is shown that the frequency-dependent input impedance of a lossless distributed network may be represented by the frequencies of the input impedance poles and zeros. Then, given the network reactance at a single frequency other than that of a pole or zero, one may apply Foster's reactance theorem to determine the input impedance at any frequency. Using the frequency-dependent impedance representation, one may calculate the response of the system to any periodic driving function. Author (NSA)

N67-34353# California Univ., Berkeley. Lawrence Radiation Lab.
SEARCH FOR HYPERONS AND BOSONS BELONGING TO HIGHER SYMMETRIES
Gerson Goldhaber Feb. 1967 46 p refs Presented at the Conf. on Symmetry Principles at High Energy, Coral Gables, Fla., 24–27 Jan. 1967
(Contract W-7405-ENG-48)
(UCRL-17388; CONF-670108-3) CFSTI: HC$3.00/MF$0.65

A discussion is given on the evidence found for the existence of higher symmetry groups. A review of the experimental situation is given. The topics covered are the possible existence of $K\pi\pi$ I=3/2 and K^+K^+, I=1, S=2 states, the $p\pi^+\pi^+$ mass peak at 1560 MeV or a study in reflections, and the search for positive-strangeness hyperon resonances. NSA

N67-34360# Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Strahlenschutz.
MEASUREMENT OF THE FLUX DENSITY AND DOSE RATE EQUIVALENT REMOVAL CROSS SECTIONS OF VARIOUS ATTENUATION MATERIALS FOR NEUTRONS [MESSUNG VON FLUSSDICHTE- UND DOSISLEISTUNGS BESEITIGUNGSQUERSCHNITTEN VERSCHIEDENER ABSCHIRMMATERIALIEN FUER NEUTRONEN]
D. Nachtigall and M. Heinzelmann Dec. 1966 24 p refs In GERMAN; ENGLISH summary
(JUL-435-ST) CFSTI: HC$3.00/MF$0.65

The attenuation of neutrons was investigated for different materials. Measured were the removal cross sections and the build up factors for the neutron flux density and the dose rate equivalent for neutron energies from 0.03 to 4.5 MeV. Flux density and dose rate equivalent were measured independently from thermal neutron energy to the maximum energy. Measurements were made with radioactive neutron sources and at the reactor. Results of the long counter and the Andersson and Braun dosimeter are compared with results of a scintillation counter with five different polyethylene spheres. Author

N67-34365 European Organization for Nuclear Research, Geneva (Switzerland).
POSSIBLE AND IMPOSSIBLE PHASE-SPACE TRANSFORMATIONS BY MEANS OF ALTERNATING-GRADIENT DOUBLETS AND TRIPLETS. APPLICATION TO THE TURNOVER OPTICS OF AN RF SEPARATOR
E. Regenstreif 29 Mar. 1967 69 p refs
(CERN 67-8)

General analytic conditions previously investigated for achieving simple phase-space transformations by means of an arbitrary multiplet are applied to conditions of alternating-gradient (AG) doublets and triplets in order to investigate the practical feasibility of achieving transfer matrices of the form specified. Potentialities are shown of the triplet for providing turnover in one plane, real images and minus unit magnification in both planes, and stigmatism in addition to these properties. R.U.

N67-34397# California Univ., Berkeley. Lawrence Radiation Lab.
STRONG INTERACTIONS AND THE 200 GeV ACCELERATOR
Geoffrey F. Chew 29 Mar. 1967 19 p Presented at the Agonne Meeting, 7–8 Apr. 1967
(Contract W-7405-ENG-48)
(UCRL-17483) CFSTI: HC$3.00/MF$0.65

The discussion of strong interactions and the 200-GeV accelerator includes a brief survey of the existing state of knowledge, and some arguments that the contemplated increase of energy will be of qualitative value to the internal development of a strong interaction theory. NSA

N67-34399# Institute of Nuclear Sciences, Lower Hutt (New Zealand). Dept. of Scientific and Industrial Research.
REPORT ON THE WORK OF THE INSTITUTE OF NUCLEAR SCIENCES Progress Report, May–Dec. 1966
Dec. 1966 77 p refs
(INS-229; NP-16698; PR-8)

Research projects in nuclear physics, radiation applications, isotope geochemistry (stable isotopes), radioactive dating and fallout, isotope applications, and instrumentation are discussed. NSA

N67-34425# Wayne State Univ., Detroit, Mich. Dept. of Physics.
REPORT ON MEASUREMENT OF THE ANGULAR CORRELATION OF POSITRON ANNIHILATION RADIATION FROM CERIUM HYDRIDE
D. R. Gustafson [1966] 19 p refs Prepared for Sandia Corp., Albuquerque, N. Mex.
(Contract AT(29-1)-789)
(SC-CR-67-2572) CFSTI: HC$3.00/MF$0.65

The angular correlation of positron annihilation radiation from cerium hydride as a function of H/Ce was examined. The angular correlations for H/Ce=2.0, 2.3, 2.4, 2.5, 2.6 were found to be nearly independent of H/Ce over this range and similar to the angular correlation from lithium hydride measured by others. The results are consistent with the model of the electronic structure of cerium hydride where hydrogen atoms are assumed to be present as anions. However, certain ambiguities in the data caused by problems with background and sample alignment could not be eliminated and the protonic model cannot be ruled out. Author (NSA)

N67-34440# Oak Ridge National Lab., Tenn. Health Physics Div.
MEAN EXCITATION ENERGIES CALCULATED FROM STOPPING-POWER AND RANGE DATA

Patricia Dalton (M.S. Thesis—Vanderbilt Univ.) and J. E. Turner Jun. 1967 55 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1777) CFSTI: HC $3.00/MF $0.65

Mean excitation energies (I values) have been calculated from the data of nine key experiments that measured absolute stopping power, relative stopping power, or range. New shell corrections (C/Z) for the entire atom are included. I values obtained from relative stopping-power measurements have been normalized to I = 163 eV for aluminum and I = 314 eV for copper. The results of the analysis indicate that: (1) the absolute stopping power data of Sachs and Richardson does not fit the general trend described by the other data; (2) a standard reference on stopping power, National Bureau of Standards Handbook 79, Stopping Powers for Use with Cavity Chambers (1961), which does not include the more recent data, does not include adequate shell corrections; (3) agreement is good with a recent report of the National Academy of Sciences–National Research Council, Studies in the Penetration of Charged Particles in Matter (1964), which includes suggested I values based on empirical estimates of the shell corrections; and (4) a good estimate of I (eV) can be found from equations presented. Author (NSA)

N67-34445# United Kingdom Atomic Energy Authority, Culham (England).
LOSS CONE INSTABILITY IN THE STELLARATOR
A. A. Galeev Feb. 1967 11 p refs Transl. into ENGLISH of Preprint No. 10 of Inst. of Nucl. Phys., Siberian Branch, USSR Acad. of Sci., Novosibirsk, 1966 p 1–11
(CTO/366; NP-TR-1530) CFSTI: HC $3.00/MF $0.65

The stability of the particle velocity distribution in systems with rotational transform of the lines of force is investigated. The longitudinal ion and electron velocity distributions have a saddle whose width depends on the perpendicular velocity and the position in space. It is shown that the development of the instability leads to the rapid filling of the so-called loss cone; the particle lifetime in the loss cone is of the order of their lifetime limited by toroidal drift to the walls. The plasma lifetime increases compared with the latter in the ratio of the thermal velocity of the electrons to the width of the saddle in the distribution: $\omega_{He}\tau = rR_{0c}^2\theta/r_{He}^3$. Author (NSA)

N67-34446# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
COHERENT PRODUCTION OF PARTICLES IN COLLISIONS OF 200 GeV PIONS WITH EMULSION NUCLEI
Z. Czachowska, J. Gierula, S. Krzywdzinski, M. Miesowicz, K. Rybicki et al 1967 12 p refs
(INR-774/VI/PH)

In about 75 liters of nuclear emulsion irradiated by the primary cosmic radiation 62.86 m of secondary tracks were systematically traced. These tracks belong to mesons of median energy of about 200 GeV produced in interactions of ultra high energy nucleons with emulsion nuclei. Among 144 jets found in this way about 9% represent events with $N_h=0$ and $n_s=3$ or $n_s=5$ nearly all of which have all features of diffraction dissociation of pions. Author (NSA)

N67-34484 Polish Academy of Sciences, Cracow.
ELASTIC ELECTRON SCATTERING FROM NUCLEI AND NUCLEON–NUCLEON CORRELATIONS [ELASTYCZNE ROZPRASZANIE ELEKTRONOW NA JADRACH ATOMOWYCH I KORELACJE MIEDZYNUKLEONOWE]
W. Czyz and L. Lesniak Apr. 1967 10 p refs Submitted for publication
(INP-540/PL)

Derived are arguments in support of the hypothesis that elastic electron scattering from nuclei at large momentum transfers is very sensitive to the dynamical short range nucleon–nucleon correlations. S.C.W.

N67-34485 European Organization for Nuclear Research, Geneva (Switzerland).
EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH Annual Report, 1966
1967 167 p refs
(AR-12)

Reported are activities of the European Organization for Nuclear Research in the areas of nuclear physics; theoretical physics; applied physics; and accelerator research. Included are data on the Administration Department; publications; lectures and seminars; and academic and training programs. S.C.W.

N67-34498# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
THE ONE-VELOCITY NEUTRON FLUX DISTRIBUTION IN A CYCLINDRICAL CELL
S. A. Kushneriuk May 1967 37 p refs
(AECL-2709; CRT-1258) CFSTI: HC $3.00/MF $0.65

Formulas are presented which describe the neutron flux distribution, in the one-velocity approximation, in a cylindrical lattice cell. They are based on the solution of the integral equation for the neutron flux in a cell which is of infinite extent and consists of a thick medium which scatters neutrons isotropically, and contains a uniform distribution of isotropic neutron sources and an axially located neutron absorbing rod and sheath. Specifically, some of the formulas given are for the extrapolation length, the ratio of the surface to average flux in the rod, and the transient functions associated with the description of the neutron flux distribution near the absorbing rod. The formulas presented are derived from considerations of the neutron transport equation in the one-velocity limit. Author

N67-34520# Nihon Univ., Tokyo(Japan). Dept. of Physics.
DEFORMABLE SPHERE MODEL OF ELEMENTARY PARTICLES AND ITS RELATION TO QUARK
Osamu Hara, Tetsuo Goto, S. Y. Tsai and Haruichi Yabuki 1967 160 p refs
(NUP-A-67-8) CFSTI: HC $3.00/MF $0.65

The deformable sphere model of elementary particles is discussed as a generalization of the rigid body model. It is shown that the ground state of the deformable sphere corresponding to a given spin can be described in terms of excitons which describe the rotation and the deformation of the sphere. It is shown that as far as the spin and the unitary spin quantum numbers are concerned, these excitons can be identified with the quark and the antiquark. Author

N67-34521# United Kingdom Atomic Energy Authority, Harwell (England). Research Reactors Div.
AFCA2, A COMPUTER PROGRAM FOR THE ANALYSIS OF DATA FROM AN AUTOMATIC FOIL COUNTER
E. D. Jones and E. A. Baker Mar. 1967 105 p refs
(AERE-R-5315) HMSO: 12s

The Automatic Foil Counter is used for gamma-counting foils with activities up to 5μCi. Two sets of scintillation counters are available for gamma energies above and below 0.25 MeV. The irradiated detectors of any reasonable geometric shape are supported in trays which are loaded manually into the counter. Each load of trays will contain detectors, standard foils, and empty trays which act as backgrounds. The detectors are cycled past the scintillation counters and counted automatically (in one of five possible modes of operation of the counter), and the results are punched on IBM cards. For analysis by the computer program

AFCA2 any single load may contain detectors of more than one nuclide, different types of detectors from the same nuclide, and detectors from different irradiations, providing the counting conditions are similar. The limitations for each load are 120 trays, 10 counting cycles, 4 different types of detector, and 10 different irradiations. Author

N67-34522 European Organization for Nuclear Research, Geneva (Switzerland).
MEASUREMENTS OF STACKING EFFICIENCY WITH THE CERN ELECTRON STORAGE AND ACCUMULATING RING (CESAR)
E. Jones, H. Koziol, L. Magnani, and M. J. Pentz 19 Apr. 1967 18 p refs
(CERN-67-11)

Experimental results indicate that reasonable stacking efficiencies can be obtained with the CERN electron storage and accumulating ring (CESAR) even at high values of Γ for a sufficiently large number of pulses. Combined effects of frequency noise on the scanning buckets and the limited lifetime of the circulating beam due to gas scattering explain the deviation in the range of results. The agreement between experiment and computation is not good for the stacking efficiency ϵ, and this is attributed to influences of beam intensity, noise level, and variation in lifetime with the position in the vacuum chamber; as well as to limited computational accuracy and arbitrary choice of noise level. M.W.R.

N67-34523# Chicago Univ., Ill.
SPECTROSCOPIC RESEARCH Final Report, 15 Jan. 1963–31 Mar. 1967
Robert S. Mulliken 31 May 1967 10 p refs
(Contract AF 19(628)-2474)
(ARCRL-67-0288; AD-654005) CFSTI: HC $3.00/MF $0.65

Progress was made in the interpretation of the N2 bands, including a discussion of predissociations in the C(3)Pi-u state, and the relation of this state to the upper state of the Goldstein-Kaplan bands. A thorough study of the He2 molecule was carried through. Many new vibrational levels in known electronic levels, and many new electronic levels were discovered, including a number of higher members of Rydberg series. Further information was obtained on the behavior of the spectrum and structure of the third group hydrides. The emission spectrum of Cl2(+) was reinvestigated under high resolution. In spite of an unprecented exhaustive experimental study (using Cl isotopes) to examine all possible details, the spectrum still presents some puzzling features which are not yet fully understood theoretically. Author (TAB)

N67-34540# Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. of Physics.
APPLICATION OF METHODS COMMON TO ELEMENTARY PARTICLE PHYSICS AND MANY-BODY PROBLEMS Final Rept. 15 Nov. 1965–15 May 1967
Gerhard Jacob May 1967 12 p refs
(Grant DA-ARO-49-092-66-G102)
(Rept.-2; AD-653624) CFSTI: HC $3.00/MF $0.65

The problem of broken symmetries in Quantum Electrodynamics was investigated. The role played by current non-conservation and the relation of those non-conserved currents to the Goldstone theorem was clarified through a classical example (the Heisenberg Ferromagnet) and in a Quantum Electrodynamical calculation. It was concluded that spontaneously broken symmetries may be generated by currents with non zero divergence. A distinction is made between two ways of spontaneous symmetry breaking: Local breaking and asymptotical breaking. Finally, the problem of electrons as charged neutrinos was studied quantitatively. Four problems in nuclear physics were and are being studied. The first one was solved and is concerned with the exact sum of the four particle correlation diagrams using the Bethe-Faddeev equation. Two problems concerned with (p,2p) reactions (150-45MeV) are under study, and consist of an investigation of quasi-free diffraction scattering in medium weight nuclei and of a consistent calculation of the distorted momentum distribution in light nuclei. Finally, one problem on the statistical perturbations of angular correlations is being worked on. Author (TAB)

N67-34550# National Bureau of Standards, Boulder, Colo. Radio Standards Lab.
ON THE NATURAL SHIFT OF A RESONANCE FREQUENCY
Robert J. Harrach 29 Sep. 1966 31 p refs
(NBS-TN-346) GPO: $0.25

The natural resonance frequency shift, caused by the transition-inducing radiation field, is examined for a magnetic dipole transition between hyperfine structure levels in the ground state of a thallium atom. A calculation predicts, for an atomic beam experiment, a natural shift magnitude of 1.4 parts in 10^{10} of the thallium resonance frequency, per mW/Oe. In the experiment, frequency shifts caused by overlap of neighboring resonances were observed, but the natural shift was unresolved, indicating that its size is more than an order of magnitude below the calculated value. Subsequently it has been shown that the natural shift was inhibited by the particular radiation field mode used in the experiment. When the theory correctly takes this mode into account, the calculated natural frequency shift is consistent with the experimental results. Author

N67-34569# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
PHOTOMONOPRODUCTION OF POSITIVELY-CHARGED PI MESONS BETWEEN 1.2 AND 3 GeV IN THE LABORATORY ANGLE REGION FROM 8°–20° [PHOTOEINFACHPRODUKTION POSITIV GELADENER PI-MESONEN ZWISCHEN 1.2 UND 3 GeV IM LABORWINKELBEREICH VON 8°–20°]
P. Schmueser (Physikalisches Staatsinstitut) Mar. 1967 70 p refs In GERMAN; ENGLISH summary
(NP-16741)

The reaction $\gamma + p \rightarrow \pi^+ + n$ was investigated for incident photon energies between 1.2 and 3 GeV and pion production angles between 8 and 20 degrees in the lab system. The differential cross sections $d\sigma/d\Omega^*$ show resonance structure in the energy region corresponding to the nucleon isobars $N_{3/2}^*(1920)$ and $N_{1/2}^*(2190)$. At photon energies above 1.7 GeV, the cross sections $d\sigma/dt$ drop nearly exponentially as functions of four-momentum transfer. Presently existing theoretical models are only partly successful in describing the experimental behavior. The simple peripheral model (gauge invariant one-pion exchange) predicts a t-dependence which strictly disagrees with the results of this experiment. If final-state absorption is taken into account the situation is considerably improved, but still the decrease of $d\sigma/dt$ with $|t|$ is less rapid than experimentally observed. However, this absorption model gives the correct order of magnitude for the cross sections. Interpretation in terms of Regge-π-exchange does not seem to be adequate since there is still resonance structure in the energy region considered. The vector-meson dominance model predicts values for the total cross sections which agree with the experimental results within a factor of two. Also a predicted t-dependence at 1.7 GeV is in qualitative agreement with this experiment. Author (NSA)

N67-34571# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
ON THE EXPONENTIAL MASS SPECTRUM OF ELEMENTARY PARTICLES
Edward J. Callen Mar. 1967 20 p refs
(ARL-67-0051; AD-653588) CFSTI: HC $3.00/MF $0.65

Elementary particle masses are found to be quantized exponential multiples of the electron mass. Mass relations closely approximating the Gell-Mann-Okubo relations are obtained for baryons, and mass relations accurate to 2.2% are obtained for mesons. These relations also hold for excited mass states.
Author (TAB)

N67-34580 European Organization for Nuclear Research, Geneva (Switzerland).
CHARGE TRANSPORT FROM TARGETS IN PROTON BEAMS, AS A MEANS OF MONITORING
K. Budal 11 Jul. 1967 106 p refs
(CERN-67-17)

Experiments are described using internal, external wire, and insulated plate targets. It was found that the charge removal from most targets is large and easily measured. The signal is linear with the number of interactions in the target, and no saturation effects are observed. The escape probabilities of the knock-on electrons are computed, and theoretical results for wire and plate targets are presented. It is concluded that most of the charge transport can be explained in terms of the following emission mechanisms: (1) The charge transport comes mainly from escaped knock-on electrons. (2) Shower particles carry away a small but significant amount of charge. (3) A low energy electron component present in the signal is a surface phenomenon and can be controlled.
N.E.N.

N67-34582 European Organization for Nuclear Research, Geneva (Switzerland).
EFFECT OF RADIO FREQUENCY PROGRAMME NOISE ON THE STACKING PROCEDURES IN STORAGE RINGS (WITH PARTICULAR APPLICATION TO THE CERN ELECTRON STORAGE AND ACCUMULATING RING (CESAR))
Eifionydd Jones 15 Jun. 1967 28 p refs
(CERN-67-1)

A mathematical discussion is presented on the perturbed motion of particles in almost circular trajectories in a synchronous particle accelerator. The so-called bucket theory, describing the phase space region containing the trajectories resulting from the Hamiltonian description of the motion of particles subject to acceleration, is used. It is shown that when the particle motion is subjected to small random perturbations, from ever-present electronic noise in the frequency program generator, a process similar to diffusion may occur tending to produce an average flow of particles across and between the individual trajectories of the unperturbed space. The Fokker–Planck equation in phase space is derived, and the effect of noise on the distribution of stacked particles in the CERN electron storage and accumulating ring is discussed. An experiment with noisy buckets, involving the efficiency of depletion of an existing stack, is described, and the results are considered to be in good agreement with the diffusion model.
N.E.N.

N67-34601 Tokyo Univ. (Japan). Dept. of Physics.
SOME CONSEQUENCES FROM SUPERCONVERGENCE FOR PIN SCATTERING
Keiji Igi and Saaoshi Matsuda Jun. 1967 16 p refs

Sum rules of the superconvergent type are obtained for the πN helicity-flip and helicity-nonflip amplitudes. The sum rules for the helicity-nonflip amplitudes are shown to be consistent with the Regge pole dominance model. Investigation of the sum rule for $B^{(-)}(\nu)$ led to speculation of resonances on $N\beta$-, $\Delta\gamma$- and $N\delta$-baryon trajectories.
Author

N67-34605# Michigan Univ., Ann Arbor. Dept. of Physics.
CALCULATION OF PARTICLE-HOLE STATES IN THE 2s–1d SHELL
T. Engeland and P. J. Ellis [1967] 11 p refs
(Contract Nonr-1224(59))
(AD-653978) CFSTI: HC $3.00/MF $0.65

A method was developed for calculating the positions of the particle-hole states in the sd-shell. Configurations with up to 4 holes were included. Results are presented for the nuclei oxygen-16 to neon-20.
Author (TAB)

N67-34621 European Organization for Nuclear Research, Geneva (Switzerland).
HIGH-ENERGY NEUTRINO INTERACTIONS
Enoch C. M. Young 21 Apr. 1967 124 p refs
(CERN-67-12)

The results of experimental studies made of high energy neutrino interactions using a heavy liquid bubble chamber filled with freon CF_3Br are analyzed. A theoretical review on the weak interactions involving the neutrinos is given. The basic assumptions on which the theory of weak interactions is based are discussed along with the theoretical considerations on the elastic neutrino reactions, the hyperon production, and the single pion production. The experimental apparatus and the methods by which the neutrino and antineutrino events were analyzed are described. The estimation of background events due to neutron induced interactions and due to incoming charged particles is discussed. Experimental results on the elastic neutrino interactions, the elastic production of hyperons, and the single pion production are discussed and interpreted.
R.N.A.

N67-34624 European Organization for Nuclear Research, Geneva (Switzerland).
TEST RESULTS OF DIGITIZED WIDE-GAP WIRE CHAMBERS
G. E. Chikovani, M. Fischer, M. N. Focacci, W. Kienzle, G. Laverriere et al 9 May 1967 51 p refs
(CERN-67-13) CFSTI: HC $3.00/MF $0.65

The properties of digitizing wide-gap wire spark chambers are described along with their magnetostrictive readout, readout electronics, and multispark events. Measurements and test results are briefly discussed.
R.N.A.

N67-34632 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
RELATIVISTIC TREATMENT OF MUON CAPTURE IN DEUTERIUM. APPLICATION TO THE DETERMINATION OF NEUTRON–NEUTRON SCATTERING LENGTH AND EFFECTIVE RANGE
E. Cremmer May 1967 23 p refs
(TH-203)

A relativistic calculation of muon capture in deuterium is studied. The important effect of hyperfine structure is treated relativistically. A determination of neutron–neutron scattering length and effective range is sought. Vertex functions are used to describe the proton–neutron–deuteron vertex and the Omnes method is used to compute the final state interaction. It is shown that an accuracy of 2.5% in spectrum and capture rate must allow a determination of r_{os} and a_s with an accuracy of, respectively, ±0.2 Fermi and ±0.7 Fermi.
Author

N67-34635# Societe Anonyme de Machines Electrostatiques, Grenoble (France).
OPTIMUM OPERATING CONDITIONS FOR THE NEUTRON GENERATOR [CONDITIONS OPTIMALES DE FONCTIONNEMENT DU GENERATEUR DE NEUTRONS] Annual Report, Apr. 1965–Apr. 1966

E. Vernin and J. Perdijon Brussels, EURATOM, Jun. 1967 102 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-024-64-4 IRAF)
(EUR-3210.f, Vol. II)

The first report described the behavior of the various elements making up an activation analysis installation; the subject now under investigation is the possibilities offered for analysis with this installation. A catalogue of those spectra obtained both with fast neutrons and thermal neutrons was made up. Irradiation and counting conditions were exactly defined and the standards containing 200 mg of the element to be examined were employed. From this, a table of sensitivities was calculated covering 47 elements chosen from those most frequently encountered. The installation was used for analyzing samples. The results showed that a certain number of specific analytical problems can easily be solved through activation analysis using an accelerator. Advantage was taken of the experience acquired in the use of tritium targets to carry out a statistical investigation into the behavior of 22 targets of varying origins. Author

N67-34645# Colorado Univ., Boulder. Dept. of Physics and Astrophysics.
THEORY OF ELEMENTARY PARTICLE AND NUCLEAR PHYSICS Semiannual Progress Report, 30 Sep. 1966–1 Apr. 1967
Joseph Dreitlein 5 May 1967 7 p refs
(Contract N00014-67-A-0405-0001)
(AD-653866) CFSTI: HC $3.00/MF $0.65

A brief summary is given of work completed on Regge trajectories and on ETA meson decay; and of work in progress on current algebras and on the three-body problem. TAB

N67-34680# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
CURRENT × CURRENT INTERACTION AND THE POLE MODEL OF NONLEPTONIC HYPERON DECAYS [VZAIMODEISTVIE TOK×TOK I POLYUSNAYA MODEL' NELEPTONNYKH RASPADOV GIPERONOV]
Yu. Niri, B. V. Struminskii, and A. N. Tavkhelidze 1967 7 p refs In RUSSIAN Submitted for publication
(JINR-P2-3254)

The pole model of parity violating nonleptonic hyperon decays is considered. On the basis of a current × current Hamiltonian the absolute values of decay amplitudes are calculated and the dynamical mechanism of the appearance of the $\Delta T = 1/2$ selection rule is suggested. Author (NSA)

N67-34699 United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
CALCULATED INDEPENDENT YIELDS IN THERMAL FISSION OF ^{235}U, ^{239}Pu, ^{241}Pu AND ^{233}U
E. A. C. Crouch May 1967 16 p refs
(AERE-R-5488) HMSO: 2s 6d

The independent yields of the fission products have been calculated for the thermal fission of ^{233}U, ^{235}U, ^{239}Pu and ^{241}Pu by the method of Wahl et al. Author

N67-34708 European Organization for Nuclear Research, Geneva (Switzerland).
ARE PHOTON–PHOTON SCATTERING EXPERIMENTS FEASIBLE?
Paul L. Csonka 11 May 1967 28 p refs
(CERN-67-15)

The significance of photon–photon scattering experiments and the experimental possibilities are discussed. The following techniques are mentioned: laser beams clashed with high energy gamma ray beams, flash X-ray machines, nuclear explosions, synchrotron radiation, clashing gamma ray beams. Author

N67-34726# Comitato Nationale per l'Energia Nucleare, Rome (Italy).
ON THE EXTENT TO WHICH COHERENT BREMSSTRAHLUNG FROM CRYSTALS CAN BE MONOCHROMATIZED
G. Bologna 10 May 1967 13 p refs *Its* Nota Interna No. 363
(LNF-67/32) CFSTI: HC $3.00/MF $0.65

Reported are theoretical and experimental studies of the extent to which coherent bremsstrahlung from crystals can be monochromatized. Theoretical results were obtained using the Born approximation method as well as high energy and small angle approximation. The following were accomplished: (1) evaluation of the coherent and polarized bremsstrahlung cross section, differential both in angles and energy; (2) folding of the differential cross section with the electron distribution for multiple scattering and beam divergence; (3) integration, extended to the angular region accepted by the collimator, of the expressions obtained; and (4) best choice of the crystal. Numerical results are presented for a single crystal of beryllium. It is concluded that the typical number of 2×10^{-7} photons/MeV/electron is largely sufficient for bubble chamber experiments if a beam intensity of 10^{12} electron/second is available. The noticeable reduction of the soft component of the spectrum with respect to a conventional bremsstrahlung beam as well as the high value of the polarization can be conveniently used; however, when a high photon beam intensity is required it is doubtful that an effective monochromaticity of a few percent can be obtained with this method. S.C.W.

N67-34729# California Univ., Berkeley. Lawrence Radiation Lab.
APPLICATION OF THE STARS PRODUCED IN A NUCLEAR EMULSION TO THE DETERMINATION OF A HIGH NEUTRON ENERGY SPECTRUM
Ronald P. Omberg and H. Wade Patterson Feb. 1967 30 p refs
(Contract W-7405-ENG-48)
(UCRL-17063) CFSTI: HC $3.00/MF $0.65

A method is presented for determining the relative shape of a high-energy neutron spectrum by utilizing the gray prongs produced in a nuclear emulsion. The method consists of assuming a flux shape that contains a single arbitrary parameter; this parameter is then determined by requiring the calculated number of gray prongs per star to agree with the value measured in the emulsion. The advantage of this method is that its accuracy is relatively independent of the magnitude of the energy range considered; this is because the product of the flux and the star production rate, if the cross section is assumed to be independent of energy, is relatively constant over a large energy range for fluxes that vary approximately as $1/E$. Author (NSA)

N67-34746 Syracuse Univ., N. Y. Physics Dept.
ALGEBRA OF CURRENT AND $\rho^0 \rightarrow \pi^+\pi^-\gamma$ DECAY MODE
Prem P. Srivastava Rio de Janeiro, Centro Brasileiro de Pesquisas Fisicas, 1967 8 p refs Sponsored by AEC *Its* Notas de Fisica, Vol. XII, No. 18

A current algebra technique is applied to the decay $\rho^0 \rightarrow \pi^+\pi^-\gamma$ to relate it to the decay mode $\rho \rightarrow l^+l^-$. The branching ratio $\Gamma(\rho^0 \rightarrow \pi^+\pi^-\gamma)/\Gamma(\rho^0 \rightarrow \mu^+\mu^-)$ is found to be ≈ 16. Author

N67-34747 International Centre for Theoretical Physics, Trieste (Italy).
SUPER CONVERGENT SUM RULE FOR PION PHOTOPRODUCTION ON λ^0

Prem P. Srivastava Rio de Janeiro, Centro Brasileiro de Pesquisas Fisicas, 1967 11 p refs Submitted for publication *Its* Notas de Fisica, Vol. XII, No. 17

A 'superconvergent' sum rule in the process of photoproduction of pion on λ hyperon is derived and studied within the framework of SU(3) symmetry. The sum rule is very well satisfied. The transition magnetic moment for the process $Y_1^* \rightarrow \lambda\gamma$ is predicted to be $-2/3\cdot\sqrt{2}\cdot\mu_2$-(1.15). Author

N67-34788# California Univ., Berkeley. Lawrence Radiation Lab.
CALCULATION OF STOPPING POWER AND RANGE-ENERGY VALUES FOR ANY HEAVY ION IN NONGASEOUS MEDIA
Palmer G. Steward and Roger Wallace 20 Dec. 1966 54 p refs
(Contract W-7405-ENG-48)
(UCRL-17314) CFSTI: HC $3.00/MF $0.65

A method is presented for calculating range–energy and stopping-power data for any heavy ion with $0.01 \leq \epsilon \leq 500$ MeV/ amu incident upon any nongaseous stopping medium. The method is incorporated into a FORTRAN computer program. Results for H, ^{4}He, ^{12}C, ^{20}Ne, ^{40}Ar, ^{84}Kr, ^{131}Xe, and ^{238}U ions each incident upon H_2O, Al, Cu, Ag, Pb, and U are presented. For ions with $Z \leq 10$, the program uses experimental data and a modified version of Northcliffe's method at low energy. For ions with $Z > 10$, the nuclear and electronic stopping-power theory developed by Lindhard et al. is adjusted to fission-product range data at low energy; for intermediate energies, charge-state data developed from experimental Ar range–energy data in Al is extended to other ions and stopping media. A somewhat modified Bethe's theory used by Barkas and Berger is used here for all ions at high energy. The particle ranges presented here are merely the integral of the inverse of the stopping power and do not include the effects of high-energy multiple scattering. Author (NSA)

N67-34798 Bhabha Atomic Research Centre, Bombay (India).
SPINS OF THE FIRST TWO EXCITED STATES IN ^{27}Mg BY AN ANGULAR CORRELATION TECHNIQUE IN THE REACTION $^{26}Mg(d,p\gamma)^{27}Mg$
M. A. Eswaran, N. L. Ragoowansi, and P. C. Mitra 1967 18 p refs
(BARC-276)

Proton-gamma ray angular correlation measurements, employing the method II of Litherland and Ferguson, have been made in the reaction $^{26}Mg(d,p\gamma)^{27}Mg$, using 1.80 MeV deuteron beam and detecting the outgoing protons at 0° with respect to the beam. Analysis of these measurements leads to spin assignments of 3/2 and 5/2 for the 0.98 and 1.69 MeV excited states of ^{27}Mg. The 1.69 MeV second excited state is found to decay almost completely to the ground state. Author

N67-34800# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
THE REAL PART OF π^-p ELASTIC SCATTERING AMPLITUDE IN THE COULOMB INTERFERENCE REGION AT 3.48 AND 6.13 GeV/c
A. A. Nomofilov, I. M. Sitnik, L. A. Slepetz, L. N. Strunov, and L. S. Zolin 1967 11 p refs Submitted for publication
(JINR-E1-3267)

The real part of the nuclear amplitude was determined from the interference of the Coulomb and nuclear interactions. Recoil protons were used to detect elastic scattering events for the squared four-momentum transfers of $1.22 \times 10^{-3} \leq -t \leq 4.22 \times 10^{-3}$ $(GeV/c)^2$ with the t-resolution $\Delta t \approx 1 \times 10^{-4}$ $(GeV/c)^2$. The analysis of the elastic π^-p differential cross section using the Bethe formula gives values of $a_s = (Re\ A_n/Im\ A_n) = -(0.17 \pm 0.07)$ and $a_s = -(0.22 \pm 0.09)$ for 3.48 GeV/c and 6.13 GeV/c, respectively. The similar analysis using the formula of L. D. Soloviev results in $a_s = -(0.12 \pm 0.07)$ and $a_s = -(0.17 \pm 0.09)$ for 3.48 GeV/c and 6.13 GeV/c, respectively. The experimental values of ReA_n are in agreement with those calculated on the basis of the forward dispersion relations. Author (NSA)

N67-34808*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PLANE ISOTROPIC BUILDUP FACTORS FOR BREMSSTRAHLUNG CALCULATIONS
M. O. Burrell and J. W. Watts Washington, NASA, Aug. 1967 35 p refs
(NASA-TN-D-4096) CFSTI: HC $3.00/MF $0.65 CSCL 18F

Gamma-ray isotropic dose, energy flux, and energy current buildup factors for finite slabs were calculated by Monte Carlo techniques for initial energies ranging from 0.05 MeV to 8.0 MeV with source backings from 0. mfp to 3.0 mfp and source-exit plane distances from 0.5 mfp to 7.0 mfp. Special emphasis was given to thin-source backings and to the energy range from 0.05 MeV to 0.5 MeV for these thin-source backings. Low energies were needed for accurate bremsstrahlung dose calculations and other applications for which they had not been previously available. In comparisons of the calculated finite slab buildup factors to buildup factors for infinite media generated by the moments method, differences of up to 50 percent were observed. These differences were thought to be due mainly to geometric factors. Author

N67-34819# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PERT-IV, A TWO-DIMENSIONAL PERTURBATION CODE IN FORTRAN-IV
R. W. Hardie and W. W. Little, Jr. Apr. 1967 87 p refs
(Contract AT(45-1)-1830)
(BNWL-409) CFSTI: HC $3.00/MF $0.65

PERT-IV is a two-dimensional (R-Z, X-Y, R-θ), first-order perturbation theory code for computing reactivity coefficient traverses, activity traverses, the neutron generation time, and the effective delayed neutron fraction. The input flux and adjoint flux can be taken directly from 2-D calculations or synthesized from 1-D calculations. In a 65 K memory (and 4 tapes), the code can handle 35 materials, 26 energy groups, and a 50×50 spatial mesh. Running time on a Univac 1107 is about 3 minutes. Input instructions, a sample case, and a Fortran-IV source deck listing are included. Author (NSA)

N67-34829 Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
LIFETIMES OF EXCITED NUCLEAR STATES IN ^{115}In
Andrzej Z. Hrynkiewicz, Stanislaw Ogaza, Maria Rybicka, Reinhard Kulessa, and Wladyslaw Walus (Jagellonian Univ.) Nov. 1966 18 p refs Submitted for publication
(Rept.-506/PL)

Lifetimes of the 597, 829 and 864 keV excited states of ^{115}In were measured by means of beta–gamma and gamma–gamma delayed coincidence techniques. The corresponding results are: $T_{1/2}$(597 keV) $\leq$ 200 psec, $T_{1/2}$(829 keV) = 6.00±0.12 nsec, and $T_{1/2}$(864 keV) = 1.13±0.06 nsec. Author

N67-34830 Tokyo Univ. (Japan). Inst. of Physics.
SCATTERING LENGTHS FOR COMPLEX ANGULAR MOMENTA
Masakuni Ida and Haruichi Yabuki [1967] 35 p refs

Some general properties of the scattering length as a function of complex angular momenta are studied. A product representation is introduced for it under the assumption that it is a meromorphic

function of order less than 2. Possible existence of a new vacuum trajectory is discussed in connection with the $I=0$ $\pi-\pi$ S-wave scattering length. Author

N67-34831 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
CURRENT-DIVERGENCE COMMUTATOR
F. Capra May 1967 8 p refs
(TH-202)

The equal time commutator of an axial current and an axial divergence is calculated with the help of a low energy theorem of pion–nucleon scattering. Comparing the result with the σ model, a relation between the mass, the coupling constant and the vertex form factor of the σ meson is derived. The result is also found to be consistent with the estimates of Weinberg, thus justifying the usual neglect of terms containing current-divergence commutators. Author

N67-34832 Tokyo Univ. (Japan). Inst. of Physics.
LOW ENERGY BEHAVIORS OF THE $\pi-\pi$ PHASE SHIFTS
Haruichi Yabuki [1967] 21 p refs

Behaviors of the S-wave $\pi-\pi$ scattering phase shifts at low energies are investigated in terms of the forward dispersion relations. Our main conclusions are: (1) The experimental data of Walker et al give a set of values $a_0 \approx 0.26 m_\pi^{-1}$ and $a_2 \approx -0.07 m_\pi^{-1}$ with $a_0/a_2 \approx -7/2$ as one possible solution. (2) They support the existence of a zero below threshold in the $I=0$ S-wave amplitude. Author

N67-34872# Los Alamos Scientific Lab., N. Mex.
REPORTS TO THE AEC NUCLEAR CROSS SECTION ADVISORY GROUP
H. T. Motz, comp. 11 Nov. 1966 234 p refs Meeting held in Argonne, Ill., 10–11 Nov. 1966
(Contract W-7405-ENG-36)
(WASH-1071) CFSTI: HC $3.00/MF $0.65

The status of activities in the cross-section measurement program is summarized. Preliminary data are included. NSA

N67-34885 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
ANALYSIS OF AZIMUTHAL ANGULAR DISTRIBUTIONS OF SECONDARIES FROM INTERACTIONS OF COSMIC RAY PARTICLES WITH EMULSION NUCLEI [ANALIZA ROZKLADOW KATOW AZYMUTALNYCH CZASTEK WTORNYCH Z ODDZIALYWAN PROMIENIOWANIA KOSMICZNEGO ZJADRAMI EMULSJI JADROWEJ]
C. Czachowska, A. Jurak, and A. Linscheid 1967 15 p refs
(Rept.-788-VI-PH)

Azimuthal angular distributions of 65 events of interactions of cosmic ray particles with emulsion nuclei have been studied from the viewpoint of non-colinear emission of fireballs. Significant deviation from isotropic distribution of azimuthal angles has been found in the group of events with $\gamma_c \leq 20$ where γ_c is the Castagnolli estimate of the Lorentz factor of the CM-system. No such deviation was found for events with $\gamma_c > 20$. Author

N67-34886 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
IS A ^{7}Li HYPERISOMER POSSIBLE? [CZY JEST MOZLIWY HIPERIZOMER ^{7}Li?]
J. Pniewski and Z. Szymanski 1967 22 p refs Submitted for publication
(Rept.-801-VI-PH)

The possibility of the existence of an isomeric state of ^{7}Li is considered. The conclusion appears to depend crucially on the energy of the excited state $5+/2$ of ^{7}Li. If only the spin-dependent central Λ–N forces are taken into account to explain the splitting of the states in hypernuclei then different values of parameter Δ for different states have to be considered. Tensor and spin–orbit forces might contribute to the explanation of the apparent changes of Δ for different p-shell hypernuclei in their ground and excited states. Author

N67-34887 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THE EVALUATION OF THE HEIGHT OF EFFECTIVE MUON PRODUCTION LEVELS IN E.A.S. BY MEANS OF ATTENUATION MEASUREMENTS [OCENA EFEKTYWNEJ WYSOKOSCI POZIOMU PRODUKCJI MIONOW WWIELKICH PEKACH PRZY UZYCIU METODY POMIARU ATENUACJI]
R. Firkowski, J. Wdowczyk, and A. Zawadzki 1967 13 p
(Rept.-803-VI-PH)

The upper limit of the muon effective production level height is evaluated by means of the measurement of the barometric effect of the EAS muonic component and on basis of the determination of the muon density spectrum exponent γ_μ. Both the values were obtained using a recording set of about 140000 showers of the mean size of about $2 \cdot 10^6$. The obtained corresponding results are the following: the EAS muon barometric effect $\beta_\mu = /5.2 \pm 0.7/$ % per 1 cm Hg the mean free path of muon absorption $\lambda = 690$ gcm^{-2}, the $\gamma_\mu = 2.09 \pm 0.02$. The analysis of the obtained data points out that upper limit of the effective production level $h_\mu = /10 \pm 3/$ km. Author

N67-34890# Warsaw Univ. (Poland). Dept. of Radiochemistry.
NEUTRINOS IN SUPERDENSE MATTER. V: MOTION IN VOLKOFF SPHERES
Bronislaw Kuchowicz Nov. 1966 20 p refs
(NP-16738)

In preceding papers the neutrino motion in a fluid sphere described by the Schwarzschild internal solution has been investigated. A sphere with constant mass density may be, however, described not only by the Schwarzschild internal solution but also by some solution with singularity. For these so called Volkoff spheres the neutrino motion is studied. Contrary to the behavior in the field of the internal Schwarzschild solution, the central regions of the sphere are now admitted to neutrino motion. Author (NSA)

N67-34893 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research
CORRELATED PROTON PAIRS IN A HIGH ENERGY NUCLEAR REACTION [EMISJA SKORELOWANYCH PAR PROTONOW W REAKCJACH JADROWYCH WYSOKIEJ ENERGII]
Teodor Siemiarczuk and Przemyslaw Zielinski 1967 7 p refs Presented at the 2d Intern. Conf. on High Energy Phys. and Nucl. Struct., Rehovoth, 27 Feb.–3 Mar. 1967
(Rept.-787-VI-PH)

Emission of correlated proton pairs in 780 interactions of 9 GeV negative pions with xenon nuclei has been observed. Author

N67-34916 Tokyo Univ. (Japan). Coll. of General Education.
S WAVE $\pi\ \pi$ SCATTERING WITH SMALL SCATTERING LENGTHS
Yasunori Bfji and Koichi Hayashi [1967]. 16 p refs

One of the questions concerning $\pi\ \pi$ interaction is whether the S-wave scattering lengths are large as apparently indicated by many phenomenological analyses, or small as predicted first by Weinberg on the basis of PCAC, current algebra, and the linear approximation. Presented is an analysis which demonstrates that small scattering lengths can be consistent with the recent phase

shift analysis, the forward dispersion relation, and the sum rule for the axialvector coupling constant provided that one considers a zero in each of the S-wave amplitudes. S.C.W.

N67-34919# Nihon Univ., Tokyo (Japan). Dept. of Physics and Atomic Energy.
THE DEGENERATE VACUUM AND THE INFINITE COMPONENT WAVE EQUATION
Tetsuo Goto [1967] 17 p refs
(NUP-A-67-9) CFSTI: HC $3.00/MF $0.65

In the field theoretical view point, an infinite component wave equation, which is of first order in p_μ, is derived for the one particle wave function. The mass formula are as follows: $m=\mu_0(J+1/2)$ for the simplified Heisenberg model, $m=\pm\mu_0(J+1/2)$ for the original Heisenberg model where J denotes the intrinsic spin of one particle states. Author

N67-34922# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SYMMETRIES AND CURRENT ALGEBRAS FOR ELECTROMAGNETIC INTERACTIONS
L. D. Solov'ev 1967 22 p refs Presented at the Intern. Conf. on Low and Intermediate Energy Electromagnetic Interactions, Dubna, USSR, 7–15 Feb. 1967
(JINR-E2-3203; CONF-670203-3)

Applications of the current algebras method to electromagnetic interactions are summarized and its connection with the super-covergent sum rules method is pointed out. Author (NSA)

N67-34923# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
PHOTOPRODUCTION OF POSITIVE MESONS BETWEEN 1.2 AND 3 GeV IN THE CENTER-OF-MASS ANGLES REGION FROM 2.5° TO 15° [PHOTOPRODUKTION VON POSITIVEN PI-MESONEN ZWISCHEN 1.2 UND 3 GeV IM SCHWERPUNKTSWINKELBEREICH VON 2.5°–15°]
V. Koetz Mar. 1967 57 p refs In GERMAN; ENGLISH summary
(NP-16737)

The reaction $\gamma p \rightarrow \pi^+ n$ was investigated for photon energies between 1.2 and 3 GeV and pion center-of-mass angles from 2.5 to 15°. In the energy region of the nucleon isobars $N^*_{3/2}$ (1920) and $N^*_{1/2}$ (2190) the differential cross section shows resonance structure which becomes more pronounced with decreasing production angle. The observed forward peaking in all angular distributions is in disagreement with simple one-pion exchange models. Models which take into account the interference between the one-pion exchange and the nucleon pole (s-channel) graph and also final-state absorption are in qualitative agreement with the experimental results only at small angles and low energies. Author (NSA)

N67-34927# European Organization for Nuclear Research, Geneva (Switzerland).
ANALYSIS OF HIGH-ENERGY PHYSICS EXPERIMENTS IN LABORATORIES WITH NO MEASURING EQUIPMENT
B. Maglic [1966] 7 p Presented at the Intern. Conf. on Cybernetics and Use of Computers, Hercegnovi, Yugoslavia, 1–7 Jul. 1966
(CONF-660722-1)

Three proposals for analyzing high energy physics experiments in laboratories without measuring equipment are briefly described. The first method consists of renting an IBM card puncher and sending decks of cards to CERN where they would be processed and returned. The second proposal is to connect a computer in Paris directly to the experimental set-up in CERN via TELEX lines and thus participate in the CERN experiment in real time while remaining in Paris. According to the third proposal teams participate in the experiment and its preparation and then take home the magnetic tapes for analysis. NSA

N67-34928# California Inst. of Tech., Pasadena. Synchrotron Lab.
TAGGED PHOTON BEAM SPECTRUM
Frank B. Wolverton 28 Apr. 1967 19 p ref
(Contract AT(11-1)-68)
(CALT-68-128; CTSL-33) CFSTI: HC $3.00/MF $0.65

The spectrum of photons, positrons, and electrons in a tagged photon beam was calculated. Since the energies involved were large compared to the electron mass, it was neglected in computing energy balances in the reactions considered. NSA

N67-34930# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
GAMMA-RAY SPECTROMETRY OF NEUTRON-DEFICIENT ISOTOPES Annual Progress Report
J. E. Cline and R. L. Heath Mar. 1967 67 p refs
(Contract AT(10-1)-205)
(IDO-17222) CFSTI: HC $3.00/MF $0.65

The development of FET preamplifiers at the laboratory has made it possible to achieve an energy resolution of 750 eV for 100 keV gamma rays with Ge(Li) and less than 700 eV for low-energy X-rays using Si(Li) detectors. A new preamplifier was developed for general application to high-resolution spectrometry which permits the measurement of spectra at high counting rates with no deterioration in resolution, greatly enhancing the usefulness for applications which require high resolution. As a result of the interest in using solid-state detectors for X-ray spectrometry, considerable effort was expended in a study of the operating characteristics of Si(Li) systems for such applications. Author (NSA)

N67-34934# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
SINGLE-PARTICLE WAVE FUNCTIONS OF THE ^{12}C NUCLEUS FROM ELASTIC AND QUASI-FREE ELECTRON SCATTERING [LE FUNZIONI D'ONDA DI PARTICELLA SINGOLA DEL NUCLEO DEL ^{12}C OTTENUTE DALL'ESAME DELLA DIFFUSIONE ELASTICA E QUASILIBERA DI ELETTRONI]
C. Ciofi Degli Atti 15 Jun. 1967 22 p refs
(ISS-67/14)

Using the Born approximation and the distorted-wave impulse approximation, the elastic form factor of the ^{12}C nucleus, the angular distributions and the energy spectrum of the $^{12}C(e,e'p)^{11}B$ reaction were computed with harmonic oscillator and square well wave functions. A comparison with recent experimental data was carried out and the difficulty to reconcile the usual analyses of elastic and quasi-free scattering was pointed out. Author

N67-34941# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
REGGE TRAJECTORY SPLITTING AND RELATIONS BETWEEN HIGH ENERGY CROSS SECTIONS [RASSHCHEPLENIE TRAEKTORII REDZHE I SOOTNOSHENIYA MEZHDU SECHENIYAMI PRI VYOSKIKH ENERGIYAKH]
V. G. Kadyshevskii and R. M. Mir-Kasimov 1967 11 p refs In RUSSIAN Submitted for publication
(JINR-P2-3251)

A number of relations are obtained between the cross sections for meson–nucleon and nucleon–nucleon collisions at high energies in the framework of a model unifying the Regge pole theory and the broken SU(3) symmetry scheme. Author (NSA)

N67-34942# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

DOUBLE CHARGE EXCHANGE OF π-MESONS BY NUCLEI IN PHOTOEMULSION [DVOINAYA PEREZARYADKA π-MEZONOV NA YADRAKH V FOTOEMULISII]

Yu. A. Batusov, S. A. Bunyatov, V. M. Sidorov, and V. A. Yarba 1967 26 p refs In RUSSIAN Submitted for publication (JINR-P1-3248)

The total cross sections of a double exchange of Π^+ and Π^- mesons in the energy range of 40–176 MeV are measured. The energy and angular distributions of secondary Π-mesons are given. The prong distributions of stars, accompanying these processes in photoemulsion, are discussed. The experimental results are compared to the calculations performed on the cascade model. Author (NSA)

N67-34943# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

INTEGRAL REPRESENTATIONS FOR RELATIVISTIC AMPLITUDES AND ASYMPTOTIC THEOREMS [INTEGRAL'NYE PREDSTAVLENIYA RELYATIVISTSKIKH AMPLITUD I ASIMPTOTICHESKIE TEOREMY]

G. I. Kuznetsov and Ya. A. Smorodinskii 1967 10 p refs In RUSSIAN (JINR-P2-3250)

Asymptotic integral representations for the relativistic amplitudes of particle and antiparticle scattering are obtained from the existence of the amplitude expansion in irreducible infinite dimensional unitary representations of the Lorentz group. On the basis of the integral asymptotic representations the equality of the amplitudes of high energy particle and antiparticle scattering at zero angle is proved. Author (NSA)

N67-34953 Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.

DIRECT NUCLEAR REACTIONS [REAKCJE JADROWE BEZPOSREDNIEGO ODDZIALYWANIA]

H. Niewodniczanski and A. Strzalkowski Mar. 1967 74 p refs In POLISH; ENGLISH summary (INP-525/PL)

A report on the present state of investigations of direct nuclear reactions and a general review of the usually applied formalisms are presented. Starting with the most advanced coupled channel method, different models of direct reactions are discussed; namely, the DWBA-model, the PWBA-model and also some adiabatic approximations for the particular case of inelastic scattering. The possibilities of extracting information concerning the nuclear structure are also discussed. Author

N67-34962# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

π-MESON PRODUCTION IN NEUTRON EXPERIMENTS AND CURRENT ALGEBRA [ROZHDENIE π-MEZONOV V NEITRINNYKH EXPERIMENTAKH I ALGEBRA TOKOV]

Nguyen Thi Hong 1967 7 p refs In RUSSIAN (JINR-P2-3197)

The cross sections of slow π-meson production processes by the collisions of neutrino and antineutrino with nucleons are calculated on the basis of simultaneous commutation relations of vector and axial currents. Author (NSA)

N67-34971 Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.

A NOTE ON THE DISPERSIVE CALCULATION OF SYMMETRY BREAKING CORRECTIONS TO STRONG COUPLING CONSTANTS [DYSPERSYJNA METODA OBLICZANIA POPRAWEK DO STALYCH SILNEGO SPRZEZENIA W PRZELAMANEJ SYMETRII]

Jan Kwiecinski Apr. 1967 13 p refs Submitted for publication (INP-541/PL)

The dispersive method is proposed for calculating the symmetry breaking corrections to strong coupling constants. The method is based on the dispersive representation of the suitably chosen matrix elements of current divergences. Approximation of these matrix elements in the limit of vanishing four-momentum connected with currents by nearby poles leads to group theory results for strong coupling constants. Corrections come from distant singularities and are presented in the form of dispersive sum rules. The method is illustrated on an example of BBP coupling in broken SU(3) symmetry. Author

N67-34972# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.

RADIATIVE CORRECTIONS TO LEPTONIC DECAYS AND COMPOSITE MODELS FOR STRONG INTERACTIONS

N. Cabibbo, G. Preparata (Rome Univ.), and L. Maiani 11 Jun. 1967 14 p refs (ISS-67/13)

On the basis of the requirement of finite radiative corrections for leptonic decays, we propose the abandonment of the quark model for strong interactions in favor of models based on integrally charged triplets. We discuss a model of this kind—the SUB model—based on a proposal of Han and Nambu in which most of the results of the nonrelativistic quark-model hold. Author

N67-34976# Argonne National Lab., Ill.

PHYSICS DIVISION SUMMARY REPORT, SEPTEMBER–DECEMBER 1966

Dec. 1966 69 p refs (Contract W-31-109-ENG-38) (ANL-7284) CFSTI: HC$3.00/MF$0.65

Summary information is presented on research projects pertaining to partial radiative widths in neutron capture, and final state structure; multiple excitation effects in a single particle transfer reaction; structure of early 1d2s-shell nuclei, and three-body correlations in nuclear matter. Conference reports are highlighted, and abstracts of papers accepted for publication are included. M.G.J.

N67-35002# European Atomic Energy Community, Geel (Belgium).

$^{14}C(d,n)^{15}N$ AND $^{15}N(d,n)^{15}O$ REACTIONS

M. Coppola and H.-H. Knitter Jun. 1967 22 p refs (EUR-3492.e) CFSTI: HC$3.00/MF$0.65

Angular distributions of neutrons produced in the $^{14}C(d,n)^{15}N$ and $^{15}N(d,n)^{15}O$ reactions were measured at incoming deuteron energies of 1.3, 1.8, 2.8 MeV and 1.0, 1.8, 3.0 MeV respectively, using a fast neutron time-of-flight spectrometer. Neutrons leading to the ground states and to some of the excited states of ^{15}N and ^{15}O were detected showing, in some cases, typical stripping patterns. Author

N67-35006 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

HYPERTRITON WITH SEPARABLE NONLOCAL INTERACTION WITH HARD SHELL REPULSION [HYPERTRITON Z SEPAROWALNYM NIELOKALNYM ODDZIALYWANIEM ZE SZTYWNA POWLOKA ODPYCHAJACA]

Jerzy Borysowicz and Janusz Dabrowski 1967 10 p refs (Rept.-783/VII/PL)

The ΛH^3 problem is solved exactly with separable nonlocal nucleon–nucleon and Λ-nucleon potentials with a hard shell of radius $r_c = 0.4$ fm. For three sets of Λ-nucleon scattering parameters, the binding energy and the probability of the S' state is calculated. Author

N67-35018*# Oak Ridge National Lab., Tenn.
SYSTEM RESPONSE FUNCTIONS FOR FLIGHT-TIME SPECTROMETRY OF SECONDARY FAST NEUTRONS
Robert T. Santoro (M.S. Thesis—Tenn. Univ.) Aug. 1967 122 p refs
(NASA Order R-104; Contract W-7405-ENG-26)
(NASA-CR-87805; ORNL-4114) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Time-channel response functions derived for a time-of-flight spectrometer used to measure monoenergetic secondary neutrons in the energy region from 2 to 100 MeV are discussed. The effects on the flight-time distribution of the target and detector dimensions and orientation, the spatial distribution of the beam, and the pulse-height dependent time slewing (walk) were demonstrated. Response functions were derived assuming that the neutron emission from the target is independent of the azimuthal scattering angle and the polar angle over the angular region subtended by the detector, that neutron detection may be treated in the first collision approximatin with the light being emitted uniformly from the interaction point and collected uniformly from all points in the detector volume, that the beam dimension perpendicular to the scattering plane can be ignored, and that the instrumental timing jitter can be approximated by a Gaussian distribution independent of the pulse height. Author

N67-35025# Saskatchewan Univ., Saskatoon. Dept. of Physics.
THE INELASTIC SCATTERING OF ELECTRONS FROM CARBON-12
George Atherley Bear (Ph.D. Thesis) Nov. 1966 127 p refs
(SAL-6)

Measured values of the nuclear matrix element for the 19.4-MeV level in ^{12}C are presented, and the experimental equipment which was used for this investigation of nuclear structure by the technique of electron scattering is described. The matrix element for this level was measured in the previously uninvestigated region of momentum transfers between 120 and 220 MeV/c. All present measurements were made at the largest attainable scattering angle to enhance the transverse terms in the cross section. The experimental matrix elements were compared with theoretical results both for a 1^- and for a 2^- level predicted to lie in this energy region. These theoretical particle-hole calculations show that in the region of intermediate momentum transfers investigated, the magnitude of the matrix element is most sensitive to the spin-parity assignment. The 1^- matrix element has a minimum in this region whereas the 2^- matrix element has a maximum. The measured matrix elements are in satisfactory agreement with the particle-hole calculations for a 2^- level in ^{12}C, and the present values compare favorably with other measurements in the region of overlap. Author (NSA)

N67-35027# University of Southern Calif., Los Angeles. Nuclear Physics Lab.
THE L-SHELL CORRECTION IN STOPPING POWER
Hans Bichsel Apr. 1967 21 p refs
(Contract AT(04-3)-136; Grant PHS-CA-08150)
(USC-136-120) CFSTI: HC $3.00/MF $0.65

A short description of the stopping power formula including the shell corrections is given. Extensive tables for the stopping number, B_L, and the L-shell correction, C_L, have been computed and are given. B_L and C_L are given for $0.35 \leq \beta_L \leq 0.65$ in steps of 0.05, for $0.01 \leq \eta_L \leq 0.15$ in steps of 0.01, and for $0.15 \leq \eta_L \leq 5.0$ in steps of 0.05. Author (NSA)

N67-35034 Warsaw Univ. (Poland). Dept. of Radiochemistry.
NEUTRINOS IN SUPERDENSE MATTER. V. MOTION IN VOLKOFF SPHERES [NEUTRINE W SUPERGOSTEJ MATERII V. RUCH W KULACH VOLKOFFA]
Bronislaw Kuchnowicz Nov. 1966 22 p refs

Analyses of neutrino motion in the gravitational field of superdense matter, based on the assumption of Schwarzschild internal solution in the interior of a superdense star, are generalized. These general solutions take a singular form with an additional term which makes the function e go to infinity in the origin. They are characterized by the parameter K which is interpreted as a measure of discrepancy between the Newtonian and relativistic values for the mass of the sphere involved. This parameter is equal to zero for the Schwarzschild internal solution. Author

N67-35041 Tokyo Univ. (Japan). Inst. of Physics.
PION-PION SCATTERING AND SUM RULE FOR AXIALVECTOR COUPLING CONSTANT
Yasunori Fujii May 1967 12 p refs

A discussion of the Weisberger–Alder sum rule is presented in which it is shown that the sum rule can be satisfied by the pion–pion cross section with small scattering lengths and without assuming a sigma meson if a zero in each of the S-wave amplitudes is taken into account. It was found that the scattering lengths previously published need to be modified slightly. This modification and the deviation from the linear approximation are discussed. It is concluded that the sum rule is satisfied by the cross sections expected from PCAC and current commutation relations under the conditions stipulated. N.E.N.

N67-35070 Kernforschungsanlage, Juelich (West Germany). Zentralinst. fuer Angewandte Mathematik.
THE NUMERICAL TREATMENT OF THE ENERGY DEPENDENT ONE-DIMENSIONAL TRANSPORT EQUATION WITH SPRING TERM [DIE NUMERISCHE BEHANDLUNG DER ENERGIE-ABHAENGIGEN, EINDIMENSIONALEN TRANSPORTGLEICHUNG MIT QUELLETERM]
Hans Werner Meuer and Lutz Richter Dec. 1966 56 p In GERMAN
(JUL-444-MA)

Presented are the computer programs for a numerical analysis of the one-dimensional integral-differential transport equation. Developing singularities are treated by approximating an inhomogeneous system of linear equations. Included is an example calculation for a free gas nucleus at independent angle. G.G.

N67-35090# Oak Ridge National Lab., Tenn.
A FORTRAN PROGRAM FOR ELASTIC DEUTRON SCATTERING
B. A. Robson 19 Apr. 1967 43 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1831)

A FORTRAN program was written to calculate the elastic scattering of deuterons by complex nuclei. The scattering is described by an optical-model potential which includes some tensor forces. Author (NSA)

N67-35091# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
MEASUREMENT OF THE ELECTROMAGNETIC FORM FACTORS FOR FOUR MOMENTUM TRANSFERS FROM 10 TO 110 FERMI^{-2} [MESSUNGEN DER ELEKTROMAGNETISCHEN FORMAKTOREN BEI VIERERIMPULSUEBERTRAEGEN VON 10 BIS 110 FERMI^{-2}]
Joachim Engler Mar. 1967 68 p refs In GERMAN; ENGLISH summary
(NP-16765)

Using the internal beam of DESY elastic electron–proton cross sections were measured at various angles between 32 and 130°, and with momentum transfers of $q^2 = 39$, 60, 80 and 110 f^{-2}. Two single quadrupole spectrometers, movable around a

common liquid-hydrogen target, were used for analyzing the momentum of the scattered electrons. Cerenkov and shower counters discriminated against pion and low-energy background. As a cross section reference recoil protons from elastic scattering at $q^2 = 10$ f^{-2} were used, with a quantameter serving as an intermediate monitor. The data are consistent with the Rosenbluth formula, giving real form factors G_E and G_M. Both continue to decrease with increasing momentum transfer, but somewhat faster than indicated by measurements performed so far. The comparison of the e-p cross sections with those of p-p scattering and photoproduction of pions respectively shows nearly the same exponential decrease in all three cases. Among the meson resonance models the simple dipole ansatz reproduces the form factors in the whole region up to $q^2 = 250f^{-2}$. Author (NSA)

N67-35126 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

EMISSION OF LONG-RANGE CHARGED PARTICLES IN THE FISSION OF ^{235}U INDUCED BY THERMAL NEUTRONS [EMISJA DLUGOZASIEGOWYCH CZASTEK NALADOWANYCH PRZY ROZSZCZEPIENIU ^{235}U PRZEZ NEUTRONY TERMICZNE]

M. Sowinski, J. Chwaszczewska, M. Dakowski, T. Krogulski, E. Piasecki et al Oct. 1966 14 p refs
(INR-765/IA/PL)

The relative intensities of light particles (protons, deuterons, tritons, and helium-6) associated with thermal neutron fission of uranium 235 were measured. In addition, events were observed which have been attributed to the heavier nuclei like helium-8, lithium, and beryllium. Author

N67-35131 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

EXCITATION FUNCTIONS AND ANGULAR DISTRIBUTIONS OF MULTINUCLEON TRANSFER REACTIONS IN THE INTERACTION BETWEEN COMPLEX NUCLEI [FUNCJE WZBUDZENIA I ROZKLADY KATOWE REAKCJI PRZEJSCIA WIELU NUKLEONOW W ODDZIAZYWANIU Z CIEZKIMI JONAMI]

Jan Tys 1967 10 p In POLISH; ENGLISH summary
(Rept.-791/I-A/P)

Excitation functions of 3p, 2p2n transfer reactions and exchange p on 2n reaction have been measured with C, Al, Cu, and Ta targets bombarded with ^{16}O, ^{20}Ne, and ^{22}Ne ions in the energy interval 5–8 MeV/amu. Angular distributions of ^{17}N nuclei in the 3n transfer reactions on Ta and Au, and 2n transfer reactions on Ta, Au, ^{90}Zr, ^{92}Zr, ^{94}Zr, bombarded with ^{14}N, and ^{15}N ions about 90 MeV and 100 MeV have been measured. Author

N67-35134 Laboratoire de Chimie-Physique, Orsay (France).

NONRELATIVISTIC SUM RULES AND THE BINDING ENERGY OF THE DEUTERON

K. Chadan and A. Montes Lozano Jul. 1967 16 p refs
(TH-209)

Nonrelativistic sum rules obtained in potential scattering with potentials of finite radius are used to calculate in a very simple way the deuteron binding energy from neutron–proton triplet-S phase-shift. To use these sum rules, one must know the imaginary zeros in the k-plane ($k = \sqrt{E}$), of the regular solution $\phi_l(k,r)$ of the radial Schrödinger equation. These are studied in detail for an arbitrary potential (whether having a finite radius or not), and their properties are established. It is found that these zeros are closely related to the bound states. In particular, their number is the same as the number of bound states. These facts, together with the sum rules, enable us to calculate the bound state energies in a very simple and direct manner from the phase-shift and the interaction radius, which is an arbitrary parameter in the sum rules and may be chosen as large as necessary in order to be sure that one is really outside the range of the interaction. The method is applied to the deuteron, assuming that the n–p interaction in $^3S_1$ state has a radius of the order of the triplet scattering length ($a_t = 5.4$ fermi), i.e. more than three times the triplet effective range ($r_{ot} = 1.73$ fermi). The result is 2.30 MeV, in good agreement with the experimental value 2.224 MeV. Author

N67-35157# Atomic Energy Establishment, Trombay (India).

SELF-SHIELDED CROSS SECTIONS FOR THE MAIN FERTILE AND FISSILE NUCLEI

R. Shankar Singh and G. A. Desai 1966 23 p refs
(AEET-272) CFSTI: HC $3.00/MF $0.65

Self-shielded cross-sections for Th-232, U-235, U-238 and Pu-239 which exhibit resonance behavior in their reaction cross-sections with neutrons are necessary to represent the proper effective values in a multigroup analysis of reactors and to predict accurately the reactivity coefficients due to Doppler effect etc. These have been evaluated here from resonance integral calculations under the NR approximation using the latest available resonance parameters at four temperatures (300, 750, 1500 and 2500°K) and at σ_p (potential scattering cross section per absorber atom) values of 40 and 60 barns for Th-232 and U-238 and 126, 200, 300 and 400 barns for U-235 and Pu-239. The status of resonance parameters for these elements has also been discussed in detail. Author

N67-35181 Polish Academy of Sciences, Lodz. Dept. of High Energy.

THE FLUCTUATIONS IN THE LONGITUDINAL AND LATERAL DEVELOPMENT OF EAS AND THEIR INFLUENCE UPON THE SPECTRUM OF THE RATIO OF THE MUON TO ELECTRON COMPONENT DENSITY [FLUKTUACJE W ROZWOJU PODLUZNYM I POPRZECZNYM WIELKICH PEKOW ORAZICH WOLYW NA ROZKLAD STOSUNKOW GESTOSCI SKLADOWEJ MIONOWEJ DO ELEKTRONOWEJ]

J. Gawin, J. Hibner, R. Maze (Lab. of Cosmic Phys.), J. Wdowozyk (Lodz Univ.), and A. Zawadzki 1967 17 p refs
(Rept.-804/VI/PH)

The fluctuations of mu component due to the longitudinal and lateral development of the electromagnetic absorption spectrum were found experimentally in an indirect way. The value of their standard deviation is $\sigma = 0.34 \pm 0.05$. This value seems to be in a good agreement with a theoretical one ($\sigma = 0.30$) previously calculated. The apparently small value of σ can be satisfactorily explained on the basis of a quite strong negative correlation between the mean muonic radius $\bar{r}_\mu$ and the electromagnetic absorption spectrum size N_e at constant total energy E_0. This negative correlation leads to a positive correlation between Δ_μ and Δ_e when measured in the central part of a shower of constant size. The decreasing of the $\delta(\Delta_\mu/\Delta_e)$ as compared to the $\delta(\Delta_\mu/\Delta_e) = 0.51$ results from the compensation due to the above mentioned positive $\Delta_\mu - \Delta_e$ correlation. Author

N67-35197 Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Physikinstitut.

MODIFIED DISTRIBUTION FUNCTION IN THE THEORY OF MULTIPLE ELECTRON SCATTERING [MODIFIZIERTE VERTEILUNGSFUNKTIONEN IN DER THEORIE DER ELEKTRONENVIELFACHSTREUUNG]

Hans Baier 1963 10 p refs In GERMAN
(SGAE-PH-62/1967)

Discussed is an approximation method for the combined position error and flight direction correlating distribution functions of electron scattering. The Gaussian distribution function was utilized to determine the primary scattering values, and superposition was used to determine the large angle scattering involved. Electron energy loss was not included. Author

N67-35200# Idaho Nuclear Corp., Idaho Falls. National Reactor Testing Station.
NEUTRON TOTAL AND ABSORPTION CROSS SECTIONS OF ^{238}Pu
T. E. Young, F. B. Simpson, J. R. Berreth, and M. S. Coops (Calif. Univ., Berkeley. Lawrence Radiation Lab.) Mar. 1967 81 p refs
(Contract AT(10-1)-1230)
(IN-1026) CFSTI: HC $3.00/MF $0.65

The neutron total cross section of ^{238}Pu was measured from 0.008 to 6500 eV. These data give single-level Breit–Wigner parameters for resonances below 200 eV. The observed total cross section at 2200 m/sec is 586 barns. A value of 532 barns was calculated for the effective (equivalent 1/v) thermal absorption cross section. Parameters of individual resonances below 200 eV and average parameters at higher energies give a resonance absorption integral of 164±15 barns, and a value of $1.10 \pm 0.20 \times 10^{-4}$ for the s-wave neutron strength function (Γ_n/D). Author (NSA)

N67-35205# Atomic Energy Commission, Washington, D. C.
SUMMARIES OF PHYSICAL RESEARCH IN HIGH ENERGY PHYSICS
May 1967 144 p
(TID-4005, Pt. 6) CFSTI: HC $3.00/MF $0.65

The theoretical and experimental research being conducted by the major accelerator facilities, and university groups who used these facilities, is surveyed. Abstracted data are presented on each project to show the scope and progress of the work. These include the construction and operation of accelerators, the development of particle detection and data analysis systems, extensive experimental research programs using the accelerators and auxiliary equipment, and the conduct of theoretical research projects which interact with the experimental effort. A subject index is included. M.G.J.

N67-35207 Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
INFLUENCE OF THE EXPERIMENTAL ERRORS ON THE DETERMINATION OF THE OPTICAL MODEL PARAMETERS FOR ALPHA PARTICLES
Andrzej Budzanowski, Rafal Dymarz, Kazimierz Grotowski, and Adam Strzalkowski 1967 18 p refs
(Rept.-544/PL)

Angular distribution of 24.7 MeV alpha particles scattered elastically on Co nuclei has been analysed by means of the optical model of the interaction. The influence of different kinds of experimental errors on this analysis has been studied. These errors are as follows: individual errors of successive experimental points in the angular distributions, the error in the absolute value of the cross-section, the error in the estimation of the zero point of the angular scale and error in the measurement of the energy of incident particles. Author

N67-35213 Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
EXTENSIVE AIR SHOWERS OBSERVED IN THE EMULSION CHAMBER
M. Akashi, Z. Watanabe, J. Nishimura, K. Niu, T. Taira et al 1967 24 p refs *Its* Notas de Fisica, vol. VII, no. 16

Large emulsion chambers (about 10 m^2 area) exposed at mountain altitudes (5500 m and 2800 m) provide us means of observing the highest energy particles of EAS cores. Lateral distribution of the high energy γ rays in a cascade shower, properties of successive interactions in the atmosphere, and analysis of the core structure are discussed using the data observed in our chamber. Author

N67-35214 Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
OBSERVATION ON EXTREMELY HIGH ENERGY NUCLEAR EVENTS BY THE EMULSION CHAMBER
M. Akashi, Z. Watanabe, J. Nishimura, K. Niu, T. Taira et al 1967 27 p refs *Its* Notas de Fisica, vol. XII, no. 15

An analysis is presented on the nuclear interactions (incident energy $\geq$100 TeV) observed by the emulsion chamber exposed at Mt. Chacaltaya and Norikura. Measurements are made on transverse momentum, and energy spectrum of γ-rays (π^0-mesons) and secondary interactions (survival nucleons, charged π-mesons, ...). The inelasticity of nucleons and mesons and the transverse momentum of a fire ball are derived from the above results. Consistencies are examined among the results of the present work and of others. Author

N67-35216* Farnham (Frank C.) Co., Philadelphia, Pa.
***H*-FUNCTIONS IN THE THEORY OF RESONANCE RADIATION TRANSFER [*H*-FUNKTSII V TEORII PERENOSA REZONANSOGO IZLUCHENIYA]**
V. V. Ivanov and D. I. Nagirner Washington, NASA, Jul. 1967 15 p refs Transl. into ENGLISH from Astrofizika, v. 1, no. 2, Jun. 1965 p 143–156
(Contract NASw-1497)
(NASA-TT-F-11108) CSCL 20H

Radiation transfer in a Doppler-broadened resonance line is investigated. A semi-infinite atmosphere with negligibly small absorption in the continuous spectrum is considered. Approximation of complete frequency redistribution is used. The intensity of emergent radiation is expressed in terms of the appropriate *H*-function. Five-value $H(z, \lambda)$ tables are given for a large selection of values for λ. Special attention is given to values of λ close to unity. The asymptotic behavior of $H(z, \lambda)$ is investigated for $z >> 1$. It is demonstrated that, for $z >> 1$, the function $H(z, \lambda)$ depends not on the variables z and λ themselves, but only on certain combinations of them. Areas of applicability and accuracy of the obtained asymptotic expressions are evaluated. It is found that the area of applicability is quite broad and the accuracy sufficiently high to assure their practical validity. Author

N67-35220 European Organization for Nuclear Research, Geneva (Switzerland).
HIGH-ENERGY REACTIONS AND REGGE POLES
H. M. Chan 21 Jun. 1967 51 p
(CERN-67-16)

The reasons why the Regge hypothesis was made for the relativistic scattering of elementary particles is discussed. The potential scattering is considered, beginning with the nonrelativistic model of Schroedinger scattering, and typical Regge trajectories are illustrated. A representation of the scattering amplitude is deduced by means of the Sommerfeld–Watson transformation. The different roles played by Regge poles in relativistic scattering and in potential scattering is pointed out, and the extension of Regge poles to the relativistic scattering is investigated. Applications of the Regge model to high energy hadron reactions are described. N.E.N.

N67-35232# California Univ., Berkeley. Lawrence Radiation Lab.
NUCLEAR CHEMISTRY DIVISION ANNUAL REPORT, 1966
B. B. Cunningham, F. L. Reynolds, and F. S. Stephens, ed. Jan. 1967 419 p refs
(Contract W-7450-ENG-48)
(UCRL-17299) CFSTI: HC $3.00/MF $0.65

Research progress is reported in the fields of nuclear spectroscopy, nuclear reactions and scattering, nuclear structure theory, fission, hyperfine interactions, mass spectroscopy, chemistry, separation and purification, and instrumentation. In addition to

these 133 separate project reports, abstracts are presented for 15 M.S. and Ph.D. theses dealing with nuclear chemistry. An author index includes papers published and University of California Lawrence Radiation Laboratory reports issued during 1966, as well as the contributors to this report. M.W.R.

N67-35271# Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe.
AN EXPERIMENT FOR DETERMINATION OF THE DAMAGE FUNCTION γ (T) IN GOLD [EIN VERSUCH ZUR BESTIMMUNG DER VERLAGERUNGSFUNKTION γ (T) IN GOLD]
W. Schilling and J. Voelkl Mar. 1967 51 p refs In GERMAN; ENGLISH summary
(JUL-464-RW) CFSTI: HC $3.00/MF $0.65

An experiment to determine the so-called radiation damage function in gold is described. The damage function γ (Γ) is defined as the number of stable Frenkel defects produced at low temperatures by a primary atom to whom the energy Γ is transferred by irradiation with fast particles. A stack of identical gold foils was irradiated with high energy protons and α-particles. The particles are slowed down, irradiating each foil with a different mean particle-energy. The measurement of the electrical resistance change of each foil gives the total number of defects from which the damage function can be calculated. Experimental and theoretical difficulties appeared. The nonuniformity of the foil thickness resulted in errors in calculating the number of defects from the resistance change in each foil. Large corrections were necessary for increased defect production by particles scattered by large angles. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N67-33999# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
A REVIEW OF DISPERSION RELATIONS FOR LOW FREQUENCY WAVES IN QUIESCENT MAGNETO PLASMAS Final Scientific Report
Horst S. Anton (Ohio State Univ. Res. Found.) and Walter Friz Mar. 1967 22 p refs Prepared in cooperation with Ohio State Univ. Res. Found.
(Contract AF 33(615)-1915)
(ARL-67-0055; AD-653589) CFSTI: HC $3.00/MF $0.65

The work gives a summary of possible waves in a quiescent Ca-magneto plasma. Dispersion relations for the different low frequency waves are given graphically and the influence of external magnetic field strength and particle density is shown. Author (TAB)

N67-34035# Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik.
INVESTIGATION ON THE COMPRESSION AND THE CONTAINMENT OF A PLASMA IN CUSP GEOMETRY
H. J. Belitz and E. Kugler Jan. 1967 15 p refs Presented at the First European Conf. on Controlled Fusion and Plasma Phys., Munich, 1966
(JUL-457-PP) CFSTI: HC $3.00/MF $0.65

Discharging a 10 kJoule/25 kV capacitor bank on a pair of coils in such a way, that the electric currents in the two coils have opposite directions, a cusp-shaped plasma (electron densities of about 10^{17} cm^{-3}, an electron temperature up to 200 eV) is produced. The maximum magnetic field was 75 kGauss at the line and point cusps, the half-period was 3.6 μsec. Due to this short half-period the plasma could be contained no longer than 2.5 μsec. With a crowbar system (time-constant 20 μsec) the containment of the plasma was strongly improved. Using streak-camera and spectroscopical methods, the space- and time-dependence of the electron density and an estimate of the electron temperature is obtained. Author

N67-34038# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany).
THE INTERACTION OF DIAMAGNETIC PARTICLES WITH A MAGNETIC CHANGING FIELD [UBER DIE WECHSELWIRKUNG ELEKTRISCH LEITENDER PARTIKEL MIT EINEM MAGNETISCHEN WANDERFELD]
W. Peschka and B. Tries Jun. 1967 75 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-38; DVL-645)

Some calculations have been made on the interaction of diamagnetic particles with a magnetic oscillating field for energy conversion devices. It is shown that an acceleration or deceleration (a pressure increase or decrease) of a gas flow can be caused by suspension of metallic particles in the flow through the magnetic oscillating field. Further investigations in this area with regard to possible application in analogy to inductive MHD-generators are of interest. Author

N67-34039# General Electric Co., Philadelphia, Pa. Missiles and Space Div.
CORRELATION FOR ELECTRON DENSITY INTEGRAL DUE TO AIR FOR SLIGHTLY BLUNTED SLENDER CONES
Brent Kaplan Nov. 1966 15 p refs
(MEMO-113)

Presented herein are calculated values of the integral of electron density across the inviscid shock layer for a series of 8.6° sphere cones over an altitude range of 125 kft. to 225 kft. for three different hypersonic speeds. A correlation is presented, and extensions of the results downstream of the calculation points and to other geometries is briefly discussed. Author

N67-34095# Arizona Univ., Tucson. Engineering Experiment Station.
PLANE WAVE PROPAGATION THROUGH A COMPRESSIBLE INHOMOGENEOUS PLASMA
Eric Rahneberg and George Tyras Mar. 1967 27 p refs
(Contract AF 19(628)-3834)
(AFCRL-67-0299; SR-4; AD-653994) CFSTI: HC $3.00/MF $0.65

The set of hydrodynamic equations together with Maxwell's equations which describe a nonuniform plasma as formulated by Cohen was applied to a two dimensional problem where the magnetic field has only one component which is transverse to the direction of propagation and the profile is of the form (e exp. -Bx). These assumptions lead to a set of second order coupled electromagnetic and hydrodynamic differential equations which describe the region under consideration. Solutions to this coupled set were obtained by the application of the method of Frobenius. Considerable simplification resulted in the solutions when the assumption that the rms velocity of the electrons is much smaller than the speed of light was made. The resulting set of approximate solutions was applied to the problem of obtaining reflection and transmission coefficients for the case of a plane wave incident from free space upon a layer of compressible inhomogeneous plasma. Author (TAB)

N67-34114# RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.
DIAGNOSTICS OF MAGNETOPLASMAS BY LARGE ANGLE LASER SCATTERING Interim Scientific Report
I. P. Shkarofsky. Wright-Patterson AFB, Ohio, ARL, Jan. 1967. 113 p refs
(Contract AF 33(615)-2198)
(ARL-67-0020; AD-653584) CFSTI: HC $3.00/MF $0.65

A review of experiments until 1967 on laser scattering from plasmas is given which indicates that any static magnetic field if present has not been utilized for diagnostics. The Appendix summarises the theory on scattering of electromagnetic waves from an infinite magnetoplasma with arbitrary velocity distributions for electrons and ions. It is shown that one can provide large angle scattering in the plane perpendicular to the magnetic field near certain electrostatic resonances, namely the upper hybrid (when the ratio of plasma to cyclotron frequency is greater than the sq. root of 3) and the cyclotron harmonics. The perpendicular wavenumbers associated with these magnetoplasma resonances can become large. Also the plasma resonance and upper hybrid resonance at low density are discussed. For densities 10 to the 12th power to 10 to the 13th power/cc, temperatures 2000 - 3000K, and using a 10.6 micron laser, the electron velocity distribution function is obtainable from the form of Landau damping acting on the plasma resonance, whereas collisional damping is usually stronger than cyclotron damping for the other resonances. Also the damping expression for the upper hybrid at high plasma densities suffers from complexities in analysis. All resonances are useful to yield electron density and temperature from the dispersion effects. Author (TAB)

N67-34127 Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
CALCULATION OF THE TIME-DEPENDENT MAGNETIC FIELD OF A CIRCULAR-CYLINDRICAL COIL WITH RECTANGULAR CROSS-SECTION AND UNIFORM CURRENT DENSITY [BERECHNUNG DES STATIONAEREN MAGNETFELDES KREISZYLINDRISCHER SPULEN MIT RECHTECKIGEM WICKLUNGSQUERSCHNITT UND GLEICHMAESSIGER STROMDICHTE]
R. Poehlchen. Apr. 1967. 34 p refs In GERMAN; ENGLISH summary
(IPP-4/23)

A method of calculating the field intensity of a semi-infinite circular-cylindrical coil (inner radius zero) with uniform current density in the cross-section is presented. The derivation of the term for the vector-potential and the components of the field intensity from the Maxwell equations for the coil is briefly illustrated. The superposition of the fields from four such coils results in a field of a circular-cylindrical coil with rectangular winding cross-section and uniform current density. The field intensity is also obtained particularly in the region of current flow. On this basis a Fortran program was written for the calculation of the resulting field of a number of coaxial coils of this type. The program was successfully used for almost two years. The program is illustrated with examples. Standard methods of numerical mathematics by the use of calculated magnetic field intensities make it possible to evaluate other field properties. Author

N67-34128 Institut für Plasmaphysik G.m.b.H., Garching (West Germany).
MHD--STABILITY OF A BUMPY THETA-PINCH [MHD--STABILITAET EINES GEWELLTEN THETAPINCHES]
H. Wobig. Apr. 1967. 16 p refs In GERMAN; ENGLISH summary
(IPP-6/57)

Starting from the energy principle of magnetohydrodynamics the stability of a linear bumpy theta-pinch is investigated. The normal mode equations are solved with the help of a perturbation method. The expansion parameter is given. Author

N67-34162# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
ANOMALOUS DIFFUSION OF AN AFTERGLOW--PLASMA
T. Dodo. May 1967. 24 p refs
(IPP-2/62) CFSTI: HC $3.00/MF $0.65

The diffusion of a helium plasma produced in a metal chamber is investigated as a function of the magnetic field strength and neutral gas pressure. The magnetic field strength is varied from 200 to 3000 gauss and the neutral gas pressure is varied from 2×10^{-2} to 1×10^{-1} torr. A plasma is produced by a narrow electron beam on the central axis of the vacuum chamber. A Langmuir probe is inserted into the chamber off the central axis. When $\sigma_{ei}\tau_{in}$ is smaller than 1, where ω_{ei} is the ion cyclotron frequency and τ_{in} is the collision time between the ions and the neutral gas, the dependence of the diffusion coefficient on the magnetic field strength is in good agreement with the theory of classical ambipolar diffusion, although the absolute value is one order of magnitude higher. When $\omega_{ei}\tau_{in}$ is larger than 1, the density fluctuations of the plasma appear. The diffusion is anomalous and its dependence on the magnetic field strength is described by Bohm-type diffusion. Author

N67-34166# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
SOME PHENOMENA OCCURRING DURING THE INTERACTION OF AN ELECTRON BEAM WITH A MAGNETOPLAMA
Winfried Herrmann. Apr. 1967. 46 p refs
(IPP-2/61) CFSTI: HC $3.00/MF $0.65

A beam of electrons penetrating a neutral gas creates a plasma with which it interacts. It is shown theoretically that oscillations with frequencies just below the upper hybrid frequency ($\omega_H^2=\omega p^2+\omega c^2$) will be excited. In the theory the electro-static approximation is used, but a study is made of the conditions under which this approximation is valid. Oscillations near the upper hybrid frequency were detected experimentally. An experimental criterion for stability of the beam-plasma was deduced. With increasing density the excited oscillations lead to a turbulent state. This turbulent state of the system is characterized by high energy losses of the beam particles. The electric fields, which cause the energy losses of the beam particles are concentrated in a small region $d \leq 15$ cm behind the entrance slit of the beam in the plasma chamber. Increasing the interaction length does not appreciably change the losses. Author

N67-34167 Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
INVESTIGATION OF THE DYNAMICS OF A COLLISIONLESS THETA-PINCH PLASMA WITH RESPECT TO ANOMALOUS ENERGY DISSIPATION [UNTERSUCHUNG DES DYNAMISCHEN VERHALTENS EINES STOSSFREIEN PLASMAS IM VERLAUF EINER THETA-PINCH ENTLADUNG MIT BERUECKSICHTIGUNG STOSSFREIER ENERGIE-DISSIPATION]
P. Igenbergs. Apr. 1967. 56 p refs In GERMAN; ENGLISH summary
(IPP-1/61)

The dynamic behavior of a collisionless, weakly diamagnetic plasma with electron densities between 10^{11} cm^{-3} and 10^{13} cm^{-3} is studied during a theta pinch discharge in order to investigate possible collisionless dissipation mechanisms. This is done by treating a special model numerically and comparing it with experimental results. The measurements were made with a

microwave interferometer end-on and side-on and with magnetic field probes. Besides giving the electron density at the beginning of the discharge, the microwave measurements give the possibility to obtain an estimate of their time variation in the region near the axis. Eight magnetic field probes were applied at various radial points. From measurements made by a difference method it is possible to find the radial distribution of the current density during the theta pinch discharge. Author

N67-34168# Institut für Plasmaphysik G.m.b.H., Garching (West Germany).
NEUTRONS FROM D-D-REACTIONS AS A TOOL FOR PLASMA DIAGNOSTICS [REAKTIONSNEUTRONEN ALS HILFSMITTEL DER PLASMADIAGNOSTIK]
G. Lehner and F. Pohl Mar. 1967 34 p refs In GERMAN; ENGLISH summary
(IPP-1/60) CFSTI: HC $3.00/MF $0.65

The neutrons from d-d-reactions in a hot deuterium plasma can be used for plasma diagnostic purposes. The ion velocity distribution is responsible both for the total rate of neutron production and the energy spectrum of the neutrons. Anisotropic velocity distributions give rise to neutron fluxes and neutron energy spectra which are also anisotropic. These effects are discussed for generalized Maxwellian distributions (characterized by different parallel and perpendicular "temperatures") and for monoenergetic distributions (three-dimensional and two-dimensional), which serve as typical examples. Author

N67-34201# Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik.
INVESTIGATION OF THE IONIZATION OF HYDROGEN IN ELECTRICAL RING FIELDS WITH MICROWAVE DIAGNOSTICS [UNTERSUCHUNG DER IONISIERUNG VON WASSERSTOFF IN ELEKTRISCHEN RINGFELDERN MIT MIKROWELLENDIAGNOSTIK]
H. Beerwald Apr. 1967 57 p refs In GERMAN
(JUL-480-PP) CFSTI: HC $3.00/MF $0.65

Purpose of the work was to obtain quantitative information concerning the electron production which occurs when a shock-induced weakly ionized hydrogen plasma is subjected to a circular electric field of sufficient strength. The ionization of the gas was investigated in two circular field configurations: in the circular electric fields outside of the induced magnetic field; and ionization in the homogeneous inducing magnetic field. The experiments were conducted under the following conditions: (1) the mean free length of the electron paths was small in relation to the dimensions of the discharge vessel; (2) the rate of electron loss due to volumetric recombination and diffusion toward the walls were negligible when compared with the rate of ionization; and (3) the effect of the magnetic fields produced by the electron stream on the movement of the electrons was negligible, and a skin effect was not noted. Circular fields up to 200 V/cm were produced, and the time resolution of microwave interferometry was up to 7×10^{-9} sec. In general, the ionization of hydrogen in circular electric fields was found to depend on the electric field strength, the gas pressure, and the magnetic field. Transl by K.W.

N67-34228# Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik.
DIELECTRIC CONDUCTORS AND ANTENNAS FOR 2MM MICROWAVE INTERFEROMETER OF HIGH VOLUME RESOLUTION FOR DENSITY MEASUREMENTS OF PLASMAS [DIELEKTRISCHE LEITER UND ANTENNEN FUER 2MM-MIKROWELLENINTERFEROMETER HOHER RAEUMLICHER AUFLOESUNG ZUR DICHTEMESSUNG AN PLASMEN]
H. Hartwig Apr. 1967 16 p refs In GERMAN
(JUL-473-PP) CFSTI: HC $3.00/MF $0.65

Quartz rods of 3 mm diameter were used as wave guides. The interconnection between the standard hollow conductor and the dielectric conductor was in the form of a conical fitting, which eliminated mechanical, vacuum-technical, and electrical problems. The conical ends of the quartz rods were bonded into the ends of the hollow conductors with epoxy resin. Since some flexibility is needed as to where the conductor is to enter the discharge vessel, the minimum separation between conductors as well as several types of conductor curvatures were experimentally evaluated. Measured were also the radiation patterns of various bare conductor terminals. The functioning of the system was tested with a dielectric step sensitometer in an experimental interferometer arrangement with dielectric conductors and antennas. Density measurements were tested in the afterglow plasma of an electrodeless gas discharge. Transl. by K.W.

N67-34308*# Rensselaer Polytechnic Inst., Troy, N. Y. Plasma Dynamics Lab.
THE HELICAL INSTABILITY OF THE POSITIVE COLUMN IN CROSSED FIELDS AND IN ANNULAR PLASMA CONFIGURATIONS Interim Report
E. H. Holt and J. F. Reynolds Aug. 1967 10 p Presented at the 8th Intern. Conf. on Phenomena in Ionized Cases, Vienna, 28 Aug.–2 Sep. 1967
(Grant NGR-33-018-075)
(NASA-CR-87412; TR-67-4; IR-1) CFSTI: HC $3.00/MF $0.65
CSCL 20I

The helical instability typical of collision dominated plasmas has been investigated in the presence of transverse magnetic fields. In all cases the critical value of the magnetic field is very sensitive to an applied transverse component. A rectilinear transverse component destabilizes the discharge whilst a minimum B configuration has a strong stabilizing effect. A magnetic field with shear will destabilize the plasma if the shear is in the same sense as the incipient helical plasma perturbation but a shear of the opposite sense stabilizes the plasma. A coaxial plasma has been investigated in regard to its stability in a solenoidal field. It is found that improved agreement between theory and experiment for the prediction of the critical field value can be obtained if the radial form of the plasma density is taken into account in evaluating the stability criterion. When the coaxial plasma is immersed in a magnetic field with shear it is found that the consequent change in the radial form of the plasma density accounts for the major part of the change in the value of the critical magnetic field. Author

N67-34321*# Stanford Univ., Calif. Inst. for Plasma Research.
RESONANCE RECTIFICATION EFFECTS IN WARM MAGNETOPLASMAS
F. W. Crawford, R. S. Harp, and T. D. Mantei Jul. 1967 33 p refs
(Grant NGR-05-020-077)
(NASA-CR-87497; SU-IPR-177) CFSTI: HC $3.00/MF $0.65
CSCL 20I

Reviewed is a simplified explanation of the resonance rectification effect based on considerations of cold plasma permittivity. Work was conducted on resonance rectification in a plasma immersed in a magnetic field, using probe geometry such that the perpendicular component of the plasma permittivity dominates the rectification characteristics. Results of the two distinct series of resonances, which cannot be explained from cold plasma permittivity, are shown graphically. They can be elucidated by reference to warm plasma theory, by taking into account nonzero electron temperature. Characteristics of the resonances compare well experimentally with predictions based on it. R.U.

N67-34324# Kernforschungsanlage, Juelich (West Germany). Institut fur Plasmaphysik.
ON THE IMPEDANCE CHARACTERISTICS OF STATIONARY HIGH-FREQUENCY COIL DISCHARGE [ZUM IMPEDANZ-VERHALTEN DER STATIONAEREN HOCHFREQUENZRIN-GENTLADUNG]
E. Geissler Apr. 1967 19 p refs In GERMAN
(JUL-481-PP)

For the proper dimensioning of a high-frequency apparatus producing a high-frequency plasma by inductive excitation it is necessary to know the plasma impedance as a quotient of the electric field strength E and the magnetic field strength H at the wall of the discharge vessel. This relation between E and H was experimentally examined. A stationary ring discharge in hydrogen ($0.01\ Torr \leq p \leq 0.5\ Torr$) was set off in a periodically oscillating, undamped magnetic field ($f = 7.2\ MHz$, $B = \leq 35\ \Gamma$). The relation $\varepsilon = A_H + B$, $\phi = C$ is established for an extended space within the inducing magnetic field in the presence of noticeable skin effect. With the dimensions of the vessel fixed, the constants A, B, C are dependent on pressure only. Transl. by K.W.

N67-34398# California Univ., Livermore. Lawrence Radiation Lab.
CHERENKOV TRAPPING OF CURRENT LOOPS IN A PLASMA
Stephen E. Bodner 21 Feb. 1967 17 p ref
(Contract W-7405-ENG-48)
(UCRL-50187) CFSTI: HC $3.00/MF $0.65

Previous analyses of Astron trapping phenomenon have not considered the interaction of the moving current distribution with the plasma background. For example, the magnetic field associated with a current distribution has been taken as if current were located in free space, rather than in a dielectric medium that transmits the gross magnetic field properties of the Alfven speed. It is shown that for one simple idealized case the interaction with the background plasma is very strong, producing significant radiation. The interaction may be usable as a trapping mechanism for electron or ion current loops in a plasma. Author (NSA)

N67-34443# California Univ., Livermore. Lawrence Radiation Lab.
SPECTROSCOPIC DIAGNOSTICS OF THE 2X PLASMA
Frederick R. Kovar 30 Mar. 1967 30 p refs
(Contract W-7405-ENG-48)
(UCID-15107) CFSTI: HC $3.00/MF $0.65

Spectroscopic techniques were used to measure several physical quantities of the 2X mirror machine plasma for various machine conditions. Results indicated that improved vacuum obtained through the use of titanium gettering has reduced the background densities of neutral hydrogen and impurity ions and has helped maintain high electron temperatures later in time. Measurements on electron temperature employing the line intensity ratio technique indicated electron temperatures in excess of 100 eV. Under the best vacuum conditions with maximum ion density of about 5×10^{12} ions per cm^3 the neutral hydrogen background density was less than $4 \times 10^9\ cm^{-3}$. Oxygen impurity ion concentration could not be measured at the lowest injected densities but at higher densities ($\approx 2 \times 10^{13}$ ions per cm^3) it was 4% of the electron density. Author (NSA)

N67-34459* Rensselaer Polytechnic Inst., Troy, N. Y.
NON-EQUILIBRIUM PROPERTIES OF MAGNETOPLASMAS Semiannual Status Report, Sep. 1, 1966–Feb. 28, 1967
E. H. Holt, J. H. Noon, and R. L. Gunshor Jul. 1967 20 p refs
(Grant NGR-33-018-075)
(NASA-CR-87430; TR-67-3) CSCL 20I

Studies are in progress on instabilities in an arc plasma; on the current convective instability of collision dominated plasmas; and on the occurrence of non-Maxwellian electron velocity distributions in plasmas. The arc plasma facility has been constructed and put into operation. With argon gas fed continuously through a hollow cathode and the resultant ionized gas collimated by a magnetic field in the region between the anode and cathode, the arc has been operated up to a current of 80 amps and Langmuir probe measurements of the electron temperature and density have been made. Author

N67-34528# RAND Corp., Santa Monica, Calif.
A PHYSICAL MODEL OF CYCLOTRON DAMPING
R. F. Lutomirski May 1967 22 p refs
(Contract F-44620-67-C-0045; Proj. RAND)
(RM-5356-PR; AD-653926) CFSTI: HC $3.00/MF $0.65

Consideration is given to the phenomenon of cyclotron damping (or growth) of an electromagnetic wave propagating parallel to an external magnetic field in a fully ionized plasma (e.g., in the whistler mode). The basic intent is to give a derivation of the damping (or growth) rate of the wave that is based on a physical model that yields insight into the origin of the phenomenon. Cyclotron damping is governed by the energy exchange between the wave and those particles that feel the wave doppler-shifted in frequency to their own cyclotron frequency. Further, the phenomenon is asymptotic in time in the sense that, within the framework of linear theory, a dispersion relation between frequency and wave number and a damping (or growth) rate exist for these waves only as t approaches infinity. The asymptotic behavior is discussed in the context of the suggested model, and an estimate of how long one must wait before the asymptotic solutions are valid, as well as the usual linearized results, is obtained. Author (TAB)

N67-34615 European Organization for Nuclear Research, Geneva (Switzerland).
TRANSVERSE COHERENT BEAM PHENOMENA IN COLLIDING BEAM DEVICES
C. Pellegrini and A. M. Sessler 18 Jul. 1967 32 p refs
(CERN-67-19)

A general formalism is developed for the analysis of the transverse coherent motion of beams in a strong focusing storage ring. Both coherent and incoherent forces arising from either direct or wake fields are included in the analysis. The beams, in the absence of coherent motion, may move along different orbits which have both time and/or space crossings. The analysis applies to beams with arbitrary longitudinal density variations. We recover the well known results for a single coasting or bunched beam, but now generalized to include the relatively minor influence of an alternating gradient structure. Our previous results for two bunched beams which were strongly dependent on the assumed azimuthal symmetry of the machine, are now significantly modified. The analysis leads to simple ways of evaluating the coherent motion, for any given structure, and for bunched (electron) and unbunched (proton) beams. One interesting result is that for a suitable choice of the number of bunches and of the Q-value, all coherent modes are stable. The analysis also shows that a strong beam with a small coherent amplitude, can drive a weak beam to large amplitude. Author

N67-34633# Institut für Plasmaphysik G.m.b.H., Garching (West Germany).
INTERFEROMETRIC MEASUREMENTS AT ISAR I [INTERFEROMETRISCHE MESSUNGEN AN ISAR I]
A. Heiss Jun. 1967 24 p refs In GERMAN; ENGLISH summary
(IPP-1/64)

Electron density was measured by end-on observation using a differential interferometer. The space and time resolved

electron density measurements show the compression and lateral displacement of the plasma. The total number of electrons and ions inside the coil and the loss rate ($\approx 4 \cdot 10^{23}$ sec^{-1}) are calculated. The observations show that the plasma stays longer within the coil if the stored bank energy is increased. In certain cases, superimposed to the ordinary drift motion to the collector, there is an oscillation of the plasma column in the plane perpendicular to the coil. Impurities enhance the plasma end-losses. Author

N67-34652# Thomas (A. S.), Inc., Westwood, Mass.
WAVE PROPAGATION IN A NON-MAXWELLIAN MAGNETOACTIVE NONLINEAR PLASMA Final Report, 10 Jun. 1965–31 Oct. 1966
A. S. Thomas May 1967 82 p refs
(Contract AF 19(628)-5195)
(M65-4FR; ARCRL-67-0319; AD-653988) CFSTI: HC $3.00/MF $0.65

The interaction of an electromagnetic wave normally incident on a non-Maxwellian, nonlinear, magnetoactive, homogeneous plasma slab is studied. The wave is taken to be either right-hand circularly polarized or left-hand circularly polarized. First integral expressions for the conductivity are evaluated numerically as power series in field intensity. Then, using these expressions, the reflection and transmission coefficients are computed by employing the Runge-Kutta technique to integrate Maxwells equations numerically step-by-step through the plasma slab. For most of the cases considered, the reflection and transmission coefficients decrease as the incident field increases. Author (TAB)

N67-34653# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACADEMY OF SCIENCES OF THE USSR. POWER ENGINEERING INSTITUTE. PHYSICAL GAS DYNAMICS, HEAT TRANSFER AND THERMODYNAMICS OF HIGH TEMPERATURE GASES Selected Articles
28 Mar. 1967 83 p refs Transl. into ENGLISH from Fiz. Gazodinam. Akad. Nauk SSSR, Energ. Inst. (Moscow), 1964 p 29–33, 104–114
(FTD-MT-65-552; TT-67-62101; AD-653513) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. CONCENTRATION OF ELECTRONS AND NUMBER OF COLLISIONS OF ELECTRONS WITH MOLECULES OF AIR AFTER A SHOCK WAVE T. V. Bazhenova and Yu. S. Lobastov p 1–7 refs (See N67-34654 20-25)

2. METHODS OF MEASUREMENT OF FIELD OF DENSITY OF GAS FLOWS IN A SHOCK TUBE WITH HELP OF AN INTERFEROMETER S. G. Zaytsev, A. P. Shatilov, Ye. V. Lazareva, L. N. Trukhanova, L. A. Averina et al p 9–26 refs (See N67-34655 20-25)

N67-34654# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCENTRATION OF ELECTRONS AND NUMBER OF COLLISIONS OF ELECTRONS WITH MOLECULES OF AIR AFTER A SHOCK WAVE
T. V. Bazhenova and Yu. S. Lobastov *In its* Acad. of Sci. of the USSR Power Eng. Inst. Phys. Gas Dyn., Heat Transfer and Thermodyn. of High Temp. Gases 28 Mar. 1967 p 1–7 refs (See N67-34653 20-25)

Concentration of free electrons and number of collisions of electrons with molecules were calculated in order to find electrophysical parameters of plasma after a shock wave in air. Author

N67-34655# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHODS OF MEASUREMENT OF FIELD OF DENSITY OF GAS FLOWS IN A SHOCK TUBE WITH HELP OF AN INTERFEROMETER
S. G. Zaytsev, A. P. Shatilov, Ye. V. Lazareva, L. N. Trukhanova, L. A. Averina et al *In its* Acad. of Sci. of the USSR Power Eng. Inst. Phys. Gas Dyn., Heat Transfer and Thermodyn. of High Temp. Gases 28 Mar. 1967 p 9–26 refs (See N67-34653 20-25)

Methodological questions of interferometric investigations in a shock tube created in the laboratory are described. The interferometric method of investigation of high temperature gas flows permitted the authors to obtain distribution of density in flows of constant composition. An interferometer of Mach–Zender type was used. Methods of photographic recording of interference pattern are described. Processing of interferograms is discussed. Author

N67-34686 Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
ON THE MEASURABILITY OF PLASMA DRIFT VELOCITY AND LORENTZ POLARIZATION TERM BY MEANS OF MICROWAVE DRAGGING EXPERIMENTS [UEBER DIE MESSBARKEIT DER PLASMADRIFTGESCHWINDIGKEIT UND DES LORENTZ-POLARISATIONSTERMS DURCH MIKRO-WELLEN-MITFUERHRUNGSEXPERIMENTE]
M. Tutter Jul. 1967 14 p refs In GERMAN; ENGLISH summary
(IPP-3/55) CFSTI: HC $3.00/MF $0.65

The possibility of measuring the drift velocity of a plasma by means of its dragging of electromagnetic waves is discussed. As the coefficient of drag is strongly dependent on the Lorentz polarization term of the internal electric field of the plasma, such measurements should answer the question whether this term should be taken into consideration in the plasma dispersion. Author

N67-34743 Max-Planck-Institut für Physik und Astrophysik, Munich (West Germany).
EFFECTS OF MAGNETIC SHEAR ON DENSITY GRADIENT DRIFT INSTABILITIES
Kazuo Kitao Apr. 1967 33 p refs
(MPI-PAE/PL 3/67) CFSTI: HC $3.00/MF $0.65

The amounts of magnetic shear necessary to stabilize density gradient drift instabilities are estimated for a plasma with $1 >> \beta > m/M$ where β = plasma pressure/magnetic pressure, m and M are the electron and ion masses. The stability criteria for electrostatic convective modes are shown to be slightly modified from those obtained previously for $\beta < m/M$. For $\beta > m/M$, however, the unstable Alfvén type modes must also be considered. It is shown that the critical amount of magnetic shear is proportional to β^{-1} for the convective Alfvén type modes and to $\sqrt{\beta}$ for the non-convective modes. Author

N67-34755* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ALIGNED FIELDS, MAGNETO-FLUID DYNAMIC DRAG MEASUREMENTS WITH LARGE INTERACTION PARAMETER
G. Yonas [1967] 17 p refs
(NASA-CR-87814) CSCL 20I

The drag of spheres and disks has been measured in a flow of liquid sodium within an aligned magnetic field. A slightly viscous, strong field limit is discussed and explored experimentally. In this limit the drag coefficient was found to have an asymptotic dependence proportional to the square root of the interaction parameter (the ratio of magnetic to inertial force, independent of body shape). A physical model is presented along with preliminary verification of its basic characteristics. Author

N67-34782# Institut für Plasmaphysik G.m.b.H., Garching (West Germany).
ON THE TOROIDAL THETA PINCH IN M AND S CONFIGURATION [UBER DEN TOROIDALEN THETA-PINCH IN M UND S KONFIGURATION]
G. H. Wolf Jun. 1967 23 p refs In GERMAN; ENGLISH summary
(IPP-1/63)

The problems of a toroidal theta pinch in the M&S equilibrium configuration are discussed. Besides giving a brief survey of the toroidal theta pinch with a purely azimuthal magnetic field, the report discusses the results of theoretical and experimental investigations on the equilibrium and stability of M&S configurations. Such equilibrium configurations do not require a resulting azimuthal current in the plasma. Instead, the plasma column is periodically corrugated, which is characteristic of M&S configurations. In the absence of such corrugation, i.e. when the magnetic field is purely azimuthal, the plasma is not in equilibrium; the calculated accelerations agree very well with the observed motion of the plasma ring. Author

N67-34802# United Kingdom Atomic Energy Authority, Culham (England). Research Group.
ION CYCLOTRON INSTABILITIES IN THE PHOENIX APPARATUS
J. G. Cordey, L. G. Kuo-Petravic, E. G. Murphy, M. Petravic, D. R. Sweetman et al Jan. 1967 10 p refs
(CLM-R69) HMSO: 1s 6d

Instabilities which are associated with bursts of electrostatic oscillations at, or near, the ion cyclotron frequency and its harmonics are present in the PHOENIX machines both in the simple mirror and in the quadrupole magnetic well configurations. In both cases the instability is accompanied by energy spreading of the initially monoenergetic ion energy distribution though the effect is less marked in the latter. The fields have been resolved into those generated by azimuthal and axial currents and the frequency spectrum of each component has been measured. In the simple mirror the strongest signals are generated by $m = 1$ azimuthal currents which show characteristic frequency sweeps starting at the ion cyclotron frequency corresponding to the center of the machine and falling by some 10% in the duration of a burst. In the magnetic well the signals are predominantly due to axial currents and the harmonic structure varies with density. At a density of 10^9 cm^{-3} the signals occur at harmonics of the central ion cyclotron frequency (normally 25 MHz) and a frequency some 3 MHz higher, the fundamental being strongest. As the density is increased the second harmonics increase in intensity until they predominate. Further increase in density brings a sudden change to strong even harmonics and very much weaker odd harmonics. At the highest densities reached (5×10^9 cm^{-3}) bursts at a frequency about 4 MHz lower than the third harmonic appear and are accompanied by a progressive redistribution in plasma density. The results are discussed in the light of present theories. Author

N67-34837# Institut für Plasmaphysik G.m.b.H., Garching (West Germany).
INVESTIGATIONS ON MATCHING TRANSITIONS BETWEEN WAVEGUIDES AND LECHER WIRES IN THE 3CM REGION [UNTERSUCHUNGEN AN TRANSFORMATIONSGLIEDERN ZWISCHEN HOHLLEITERN UND LECHERDRAEHTEN IM 3CM-GEBIET]
H. Klingenberg, W. Makios, G. Meinhold, and A. Siddiqui Mar. 1967 24 p refs In GERMAN; ENGLISH summary
(IPP-3/53) CFSTI: HC $3.00/MF $0.65

The Lecher system developed by W. Makios was used to measure the parameters of a plasma produced in a shock tube. Investigations of the system in the 3cm microwave region showed that most of the input power is radiated into free space. The Lecher wires themselves radiate hardly any power; radiation occurs mainly at the openings of the transitions required for converting the H_{10} wave of the waveguide into the transverse wave of the Lecher line. The radiation losses varied with the standing-wave-ratio and the position of the nodes relative to that of the radiating element. Fluctuations were measured which could cause an error of $\pm 10\%$ in measurements of the plasma parameters. These include fluctuations, also due to standing waves, which take the form of variations of ohmic losses in system components (error $\pm$ 5%). The reflection losses were reduced by appropriate dimensioning (with good matching) to 40% of the input power. Author

N67-34915*# Space Sciences, Inc., Waltham, Mass.
PLASMA BOUNDARY INTERACTIONS
S. Aisenberg, P. Hu, V. Rohatgi, and S. Ziering Washington, NASA, Aug. 1967 91 p refs
(Contract NASw-1014)
(NASA-CR-868) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Interactions between moving plasmas and boundaries were studied theoretically and experimentally. The momentum and energy transport in the sheath is derived theoretically in terms of kinetic and moment equations. A new set of kinetic equations was derived in order to allow for the microscopic incorporation of ionization phenomena. The tangential drag of the plasma on the cathode and the anode is studied experimentally and it is shown that the electrode drag is appreciable. The cathode drag is larger than the anode drag because of the positive ion current to the cathode. From the drag measurement it is possible to determine the ion current partitioning to the cathode. A theorey of ion microfield emission is developed to explain the electron current emission from the cathode since the thermionic emission or field emission alone cannot account for the electron emission. The phenomena of arc retrograde motion is briefly studied and is explained in terms of a plasma phase propagation in the direction of increasing magnetic field where the ambipolar diffusion loss is reduced. The energy transport mechanisms to the electrode are analyzed to determine the dominant ones. An improved insulation structure for arc electrodes has been devised and used to increase electrode life. The problem of arc constriction is studied and it is shown that the constriction can be explained in terms of the balance between the input energy and the various energy loss modes. Experimental data is provided to confirm the theoretical dependence of arc diameter upon arc current, arc velocity, transverse magnetic field and upon reduced pressure. Author

N67-34921* General Electric Co., Philadelphia, Pa.
MHD BOUNDARY LAYERS INVOLVING NON-EQUILIBRIUM IONIZATION Quarterly Report, 25 Apr.–24 Jul. 1967
Arthur Sherman, Eli Reshotko, and Giles Crimi 24 Jul. 1967 46 p
(Contract NASw-1586)
(NASA-CR-87508; QR-2) CFSTI: $3.00 CSCL 20I

The problem being considered is the boundary layer that will develop over the segmented electrode wall in an MHD channel when a non-equilibrium plasma is flowing. In the analysis, the characteristics of the plasma sheath at the base of the continuum boundary layer as well as the variation of the electron temperature throughout the boundary layer are considered. Due to a desire to study finite electrode segments in the wall over which the boundary layer develops, a finite difference technique is used in solving the boundary layer equations to permit the study of non-similar behavior in a reasonably accurate way. Author

N67-34977# Princeton Univ., N. J. Plasma Physics Lab.
ON THE NUMERICAL SOLUTION OF POISSON'S EQUATION

Craig G. Smith May 1967 14 p refs Presented at Symp. on Computer Simulations of Plasma and Many Body Probl., Williamsburg, Va., 19–21 Apr. 1967
(Contract AT(30-1)-1238)
(MATT-538) CFSTI: HC $3.00/MF $0.65

A fast technique is presented for the repeated numerical integration of Poisson's equation in a circular domain. The method is most appropriate for fluid or guiding-center simulations of plasma, for which the potential may be expected to be a smooth function of the spatial coordinates. The equation is first Fourier transformed with respect to the azimuthal coordinate. The solution of the resulting ordinary differential equations in the radial coordinate may be expressed in terms of integrals of the charge density with kernels which are powers of r. If the charge density is represented by a finite power series, then the expressions for potential, electric field, and energy are immediately obtained and are likewise finite power series. The idea thus is to numerically fit the data (charge density) to a representation and then to analytically integrate Poisson's equation and perform the subsequent differentiations and integrations to obtain the related quantities. The fit may be accomplished by the least-squares technique. Solving for the unknown coefficients need, in effect, be done only once; the coefficients are then repeatedly obtained by only matrix multiplication. Side conditions for the fit are discussed. Author

N67-35039# Oak Ridge National Lab., Tenn. Thermonuclear Div.
ORNL TARGET PLASMA PROGRAM
R. A. Dandl, G. E. Guest, and N. H. Lazar Apr. 1967 20 p refs
(Contract W-7405-ENG-26)
(ORNL-4080) CFSTI: HC $3.00/MF $0.65

Some of the considerations underlying a proposed program for accumulating a dense energetic-ion plasma in an open-ended magnetic well by injecting fast neutral atoms into a target plasma produced by electron–cyclotron resonant heating are enumerated. A brief discussion is given of the plasma stability problems, emphasizing those aspects which bear on the target plasma program, and a summary of the known characteristics of electron–cyclotron heating. Trapping efficiency is illustrated by a detailed buildup calculation, included as an appendix. A tentative timetable showing the anticipated evolution of the program is given. Author (NSA)

N67-35225# Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik.
FINAL RESULTS FROM REFRACTION MEASUREMENTS PERPENDICULAR TO THE AXIS OF A THETA-PINCH-PLASMA [ERGEBNISSE AUS REFRAKTIONSMESSUNGEN SENKRECHT ZUR ACHSE EINES THETA-PINCH-PLASMAS]
Karl Heinz Dippel Jun. 1967 96 p refs In GERMAN
(JUL-493-PP)

Perpendicular interferometric studies on a high temperature theta-pinch hydrogen plasma established strong axial movements in the beginning discharge. This phenomenon was attributed to magnetic field inhomogeneity at the ends of the plasma column. Comparison of refractive measurements perpendicular to the plasma column axis with line and electron densities from other measurements found good agreement for line densities from radial oscillation frequencies. Refractometric determined electron densities differed with absolute intensity values in the visible spectrum; these variations were attributed to multiple shocks from the emission coefficient of the bremsstrahlung continuum. Transl. by G.G.

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N67-34022*# Illinois Univ., Urbana. Coordinated Science Lab.
AN EXPERIMENTAL INVESTIGATION OF RADIATION EFFECTS IN SEMICONDUCTORS Semiannual Status Report, 1 Jan.–30 Jun. 1967
W. Dale Compton 30 Jun. 1967 89 p refs
(Grant NsG-22862)
(NASA-CR-87410) CFSTI: HC $3.00/MF $0.65 CSCL 20L

A technique involving tunneling between a semiconductor and a superconductor is described for investigating the nature of impurity bands and the irradiation effects. A p-type silicon semiconductor containing boron was used, and the tunneling configuration was the Schottky barrier diode. Tunneling conductance curves are graphed. Spectral data taken at 6°K on pulled and float-zone grown silicon are briefly described. Recombination lifetimes in gamma-irradiated silicon are also discussed. Photoconductivity decay measurements indicate that a separate system of levels controls the lifetime in n- and p-type specimens. It was found that after annealing a shallow level 0.23 eV from the conduction band edge was introduced. Hole capture cross sections were obtained from Hall and lifetime measurements. The effects of oxygen and annealing on the recombination levels are described. N.E.N.

N67-34023*# Stanford Univ., Calif. Solid-State Electronics Lab.
FUNDAMENTAL STUDIES OF THE METALLURGICAL, ELECTRICAL, AND OPTICAL PROPERTIES OF GALLIUM PHOSPHIDE Quarterly Progress Report, 1 Apr.–30 Jun. 1967
Gerald L. Pearson 30 Jun. 1967 17 p refs
(Grant NsG-555; Proj. 5109)
(NASA-CR-87418) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Continuing research is reported in the following areas: (1) Photoconductivity of GaP doped with cobalt, iron, and titanium was measured with modified experimental techniques. The spectral photoresponse per incident photon and the dependence of photocurrent on temperature are graphed. The spectral behavior of photoconductivity is described. (2) The preparations and properties of rectifying junctions in GaP and $GaAs_xP_{1-x}$ are discussed, emphasizing the crystal structure relation to the electric properties of the junctions. Undoped and sulfur-doped crystals were grown by vapor epitaxy, and the relationship between the depth of diffusion spikes in zinc in GaP and the diffusion temperature is described. The technique for making p–n junctions by liquid epitaxy method is outlined. (3) The behavior of shallow donors of S, Se, and Te in gallium phosphide was studied to determine solubility and diffusion parameters. Experiments are described which investigated the diffusion temperature and the effects of varying sulfur and phosphorus pressures. N.E.N.

N67-34119 Technische Hochschule Munchen (West Germany).
LATTICE DYNAMICS OF QUANTUM CRYSTALS [GITTERDYNAMIC VON QUANTENKRISTALLEN]
Heinz Horner (Ph.D. Thesis) [1966] 68 p refs In GERMAN

Anharmonic effects in crystals of the light rare gases He^3 and He^4 are considered, and a formulation is used which corresponds to a condensed Bose system. Partial summation of diagrams of the customary development for anharmonic corrections permitted the treatment of crystals which usually cannot be considered due to the failure of the harmonic approximation as a starting point. This formulation also clarifies consistency problems in the approximations that were derived. A second formulation is discussed in which the free energy and the mass operator are given as a functional of the one and two point functions. The one-point functions assume the role of the balanced atom positions, the two-point functions become the phonon propagators. The characteristics of the mass operator are examined, and the approximations that were derived are numerically evaluated for He^3. Transl. by K.W.

N67-34137# Tokyo Univ. (Japan). Dept. of Physics.
S-D EXCHANGE INTERACTION IN THE SUPERCONDUCTOR
Toshio Soda, Tomifusa Matsuura, and Yosuke Nagaoka (Nagoya Univ.) 1967 33 p refs
(TUEP-67-9) CFSTI: HC$3.00/MF$0.65

The scattering of a quasiparticle in a superconductor due to a magnetic impurity is calculated by a perturbation method. A ratio is given of the dominant contribution of the successive order of terms in the perturbation series. If this ratio is greater than one, the perturbation series does not converge. This is connected with the existence of a bound state attached to the impurity atom. Following Yosida theory on the bound state due to the s-d interaction in a normal metal, we examine the possibility of a bound state in a superconductor. It is shown that, if the s-d interaction is antiferromagnetic and stronger than the pairing interaction, a bound state is formed around the impurity spin, and that, if it is weaker, an excited level appears in the energy gap irrespective of the sign of the interaction. The condition for the existence of the bound state is found to be the same as the condition for the divergence of the perturbation series mentioned above. The effect to the density of states of quasiparticles at finite concentration of magnetic impurities is briefly discussed. Author

N67-34157 United Kingdom Atomic Energy Authority, Harwell (England). Ceramics Div.
FMLS, A FULL-MATRIX LEAST SQUARES PROGRAM FOR CRYSTAL STRUCTURE REFINEMENT
B. H. Bracher and R. I. Taylor May 1967 63 p refs
(AERE-R-5478) HMSO: 8s

Described is a Fortran computer program for the refinement of crystal structures using full matrix least squares with X-ray or neutron data. The program is one of a series for a structure determination with compatible input and output. Details of the use of the program, a listing, and a glossary are given. The use of a second program, Tapedit, for handling reflection data on magnetic tape for input to FMLS, is described in an appendix to the report. Program decks are available from the authors. Author

N67-34248# Hebrew Univ., Jerusalem (Israel). Dept. of Physics.
PHYSICS OF VIBRONIC TRANSITIONS IN THE SPECTRA OF RARE EARTH IONS IN CRYSTALS Final Scientific Report, 15 Nov. 1965-15 Nov. 1966
W. Low and S. Yatsiv 25 Feb. 1967 44 p refs
(Grant AF-EOAR-66-21)
(AFCRL-67-0278; AD-653634) CFSTI: HC$3.00/MF$0.65

Vibronic transitions due to the existence of a gadolinium ion adjacent to a H(-) ion in CaF2 were investigated. The association of the RE(3+) and the H(-) ion in the host lattice is manifested by: (1) The appearance of new infra-red absorption frequencies which are not observed in undoped and hydrogenated CaF2. The frequencies depend on the particular RE ion doping. (2) Observation of new electronic transitions in the near U.V. of gadolinium due to new sites adjacent to an H(-) ion. (3) Observation of vibronic transitions separated from the corresponding parent transitions of the RE ion by the infra-red absorption frequency of the localized H(-). The IR, electronic and vibronic spectra are strongly dependent on the concentration of the RE doping, the particular dopant and the mode of annealing. Conclusions can be derived from comparison of hydrogenated and deuterated crystals. Author (TAB)

N67-34320# Joint Publications Research Service, Washington, D. C.
INFLUENCE OF NEUTRON BOMBARDMENT ON CERTAIN PROPERTIES OF TUNGSTEN
Sh. Sh. Ibragimov 14 Aug. 1967 7 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (USSR), v. 23, no. 2, 1967 p 354-357
(JPRS-42211; TT-67-32841) CFSTI: $3.00

The changes in properties of a metal upon bombardment by nuclear particles results from the formation of various types of defects. The influence of neutron bombardment and subsequent annealing on certain properties of tungsten of technical purity was studied. It was concluded that the increase in electrical resistivity of tungsten observed as a result of neutron bombardment results primarily from formation of intermediate or interstitial atoms and vacancies which are annealed at 320-475 and 800-900° respectively. The increase in hardness, i.e., radiation hardening of tungsten is related with a more complex type of defects, which are completely annealed only at temperatures of about 1350°C. R.Li.

N67-34325# California Inst. of Tech., Pasadena.
ENERGY LEVELS IN ^{23}Na
J. Dubois Apr. 1967 14 p refs
(Contract Nonr-220(47))
(AD-654153) CFSTI: HC$3.00/MF$0.65

The energy levels in 23Na have been investigated by means of the reaction 25Mg(d, alpha)23Na. Deuterons with energy of 10.0 MeV were accelerated with the ONR-CIT tandem accelerator and the reaction products were analyzed with a double-focusing magnetic spectrometer at 20 degrees, 30 degrees, and 60 degrees. The level density agrees with that for 23Mg. No evidence for levels at 2.405 and 2.870 MeV in 23Na was found. Author (TAB)

N67-34332# Aerospace Corp., El Segundo, Calif. Labs. Div.
REMOVAL OF LIQUID INCLUSIONS FROM SOLUTION-GROWN CRYSTALS
W. R. Wilcox Apr. 1967 29 p refs
(Contract AF 04(695)-1001)
(TR-1001(9230-03)-5; SSD-TR-67-99; AD-653990) CFSTI: HC $3.00/MF$0.65

Inclusions are almost invariably present in solution-grown crystals and chemicals. It is shown that a temperature gradient is a practical means of removing the liquid inclusions found in many crystals. Theoretical calculations of travel rates and energies were performed for several materials. The technique was tested experimentally, using several aqueous-grown crystals. Occasionally, inclusions were observed to exit from the cooler, top surface of the crystals, in disagreement with theoretical predictions. This unexpected behavior is probably due to a reflux-extraction mechanism in those inclusions containing both vapor and liquid. Other means of removing inclusions are discussed briefly. Author (TAB)

N67-34333# Aerospace Corp., El Segundo, Calif. Labs. Div.
FARADAY UNIPOLAR INDUCTION IN A NONIDEAL TYPE II SUPERCONDUCTOR
M. A. R. Le Blanc and E. L. Fletcher Apr. 1967 18 p refs
(Contract AF 04(695)-1001)
(TR-1001(9230-01)-5; SSD-TR-67-94; AD-653989) CFSTI: HC $3.00/MF$0.65

A Faraday unipolar inductor using a solid cylinder of a nonideal type II superconductor (unannealed Nb) constitutes a zero internal impedance generator capable of supplying appreciable electrical power and permits continuous study of the behavior of the average internal magnetic field vs the applied field. The various contributions to the observed emf are discussed in terms of the relativistic interpretation of Faraday unipolar induction. Author (TAB)

N67-34344# General Electric Co., Schenectady, N. Y. Research and Development Center.
RARE EARTH METALS, COMPOUNDS, AND SOLID SOLUTIONS
R. M. Bozorth (IBM) and C. D. Graham, Jr. Aug. 1966 50 p refs
(Rept.-66-C-225)

Experimental data are briefly summarized for the magnetic properties of rare earth metals and of alloys and compounds containing rare earth metals. Extensive references to the literature is made. Author

N67-34356# Norwegian Defence Research Establishment, Kjeller.
ACOUSTOELECTRIC OSCILLATIONS, CURRENT SATURATION AND ELECTRON DRIFT MOBILITY IN CADMIUM SULPHIDE CRYSTALS
Andreas Rannestad 18 Nov. 1966 27 p refs
(Contracts AF 61(052)-484; AF 61(052)-958)
(AFCRL-67-0285; SR-1; E-90; AD-654003) CFSTI: HC $3.00/MF $0.65

Interaction between acoustic waves and conduction electrons in the piezoelectric semiconductor CdS is considered. A short theoretical discussion of acoustic amplification, current saturation and the temperature dependence of electron drift mobility is given. Current saturation due to acoustic oscillations in CdS is observed, both in a transverse mode and in a longitudinal mode. A method for determining the threshold field for oscillation, utilizing the build up time for current saturation under applied pulsed dc electric field, is discussed. The threshold field is used to determine the electron drift mobility for photoconducting CdS in the temperature range from 204 degrees K to 438 degrees K. The temperature dependence of the mobility can be described as a combination of scattering from lattice vibration and trapping by two impurity levels. TAB

N67-34402# Royal Inst. of Tech., Stockholm (Sweden). Microwave Dept.
OPTICAL PHONON SCATTERING IN THE QUANTUM LIMIT
B. Magnusson and P. Weissglas 17 Mar. 1967 12 p refs
(Contract AF 61(052)-895)
(SR-18; RADC-TR-67-371; AD-653637) CFSTI: HC $3.00/MF $0.65

The rate of momentum and energy relaxation of electrons in a polar semiconductor in a strong magnetic field is calculated. It is shown that the low field mobility in very strong magnetic fields is lower than in the fieldfree case but that the magnetoresistance at weaker applied fields also may be negative. To first order in the applied electric field the net energy of the electrons is shown to remain constant, but as a fraction of the average electron energy is in the form of translational energy the electron temperature drops below the lattice temperature as in the absence of a magnetic field. Author (TAB)

N67-34491# Technische Hogeschool, Eindhoven (Netherlands).
SOME INVESTIGATIONS ON GERMANIUM AND SILICON SURFACES
Alexander Hendrik Boonstra (Ph.D. Thesis) 27 Jun. 1967 118 p refs
CFSTI: HC $3.00/MF $0.65

The results of theoretical and experimental investigations on the surface properties of germanium and silicon single crystals are discussed. Theoretical considerations are given to surface states and the space charge region. Experimental procedures for determining surface area and preparing clean surfaces are described. Experiments on the effect of adsorption of various gases and vapors on the surface conductivity of clean germanium surfaces, measurement of conductivity as a function of surface coverage, and field effect measurements are discussed. Experiments on gas adsorption on clean silicon surfaces, conductivity measurements on silicon single crystals, and the preparation of a layer of silicon nitride are also covered. R.N.A.

N67-34495# Technische Hogeschool, Eindhoven (Netherlands).
THE SURFACE PROPERTIES OF OXIDIZED SILICON
Else Kooi (Ph.D. Thesis) 16 Jun. 1967 151 p refs
CFSTI: HC $3.00/MF $0.65

A general review is made of the effect of silicon dioxide coatings on the surface properties of silicon and the importance of these coatings in semiconductor device technology. The formation of surface films during diffusion of phosphorus into silicon and the masking action of SiO_2 films against such diffusion are considered. The masking action is shown to be accompanied by the formation of a mixed oxide of silicon and phosphorus on the top of the SiO_2 films. The presence of such a phosphate-glass layer can greatly influence various phenomena observed in oxidized silicon. These phenomena are related to heat treatments and ionizing irradiations. The influence of imperfections at the $Si-SiO_2$ interface are taken into account as well as the possibility of charge being distributed through the oxide film. The number of imperfections and the charge distribution may change during heat treatments and ionizing irradiations. Such instability effects generally increase when electric potential differences are present in the oxidized silicon structure. Many heat treatment and irradiation effects show that hydrogen and sodium affect the oxide and interface structure. R.N.A.

N67-34519# Illinois Univ., Urbana. Dept. of Electrical Engineering.
JUNCTION EFFECTS IN COMPOUND SEMICONDUCTORS Status Report
N. Holonyak, Jr., M. D. Sirkis, B. G. Streetman, M. M. Blouke, M. G. Craford et al Apr. 1967 14 p refs
(Contract AF 19(628)-4337)
(AFCRL-67-0292; SR-8; AD-654009) CFSTI: HC $3.00/MF $0.65

The effect of donor impurity states near the indirect <100> conduction band minima on the direct-indirect transition in Ge(ASP) is discussed. Ultrathin platelet lasers of CdSe and Cd(SeS), including visible spectrum continuous (CW) operation, are described. Instabilities and self-oscillation phenomena in bulk samples of Si compensated with deep levels (Au, Co, etc.) are discussed. Author (TAB)

N67-34576# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
THE STABILITY OF THE WURTZITE LATTICE
R. J. C. Brown Apr. 1967 19 p refs
(AAEC/TM383)

A method for studying the stability of the wurtzite lattice using the inverse power repulsive potential is described. Calculations indicate that the lattice is stable when the repulsive exponent is less than about 8, and the experimental observation of a linear relationship between c/a and z is reproduced; for larger values of the repulsive exponent, the wurtzite lattice is unstable and suffers gross distortions. Author

N67-34599# Technische Hogeschool, Eindhoven (Netherlands).
PHOTOCHEMICAL INTERPRETATION OF INACTIVITY PHENOMENA IN CADMIUM SULFIDE [DIE PHOTOCHEMISCHE DEUTUNG TRAEGER ERSCHEINUNGEN IN KADMIUMSULPHID]
Ekkehard Tacholl (Ph.D. Thesis) [1967] 108 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

A theoretical and experimental study of the photochemical processes in CdS was conducted. The study demonstrated the

necessity to take stray atoms into account when developing a model of the photochemical volumetric reactions. This sets the model apart from the usual model of F center agglomeration in alkali halogenides and from conventional proposals for CdS. A critical review of the literature on the photochemical volume effects in CdS single crystal reveals that reactions in the presence of isovalent stray atoms may already occur just below room temperature. The conductivity glow curve method was used to measure the inactivity phenomena, and results are evaluated in terms of the donor–acceptor concept. Transl. by K.W.

N67-34610# Air Force Systems Command Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE TRANSVERSE MAGNETO RESISTANCE OF N-TYPE GERMANIUM IN A STRONG MAGNETIC FIELD
Sin-Fu Lan *In its* J. of Phys. 20 Dec. 1966 p 1–36 refs
(See N67-34609 20-23)

The transverse magnetoresistance of n-type germanium materials for both the acoustic and ionized impurity scattering mechanisms has been investigated. In a degenerate case under a strong magnetic field, the expressions of the magnetoresistance of germanium are obtained with respect to acoustic scattering. In the non-degenerate quantum-limited case, the expressions of the transverse magnetoresistance of germanium for both acoustic and impurity scattering are obtained respectively. Author

N67-34650# General Electric Co., Schenectady, N. Y. Research and Development Center.
EFFECTS OF MECHANICAL AND THERMAL TREATMENT ON THE STRUCTURE AND MAGNETIC TRANSITIONS IN FeRh
J. M. Lommel and J. S. Kouvel Nov. 1966 7 p refs
(Rept.-66-C-419)

Well-annealed bulk samples of the intermetallic compound FeRh exhibit a first-order transition from antiferromagnetic to ferromagnetic order on heating near 330°K. Plastic deformation has been found to convert the normal CsCl-type ordered structure of FeRh to a disordered f.c.c. structure, which is only weakly magnetic and does not exhibit the first-order transition. On annealing the disordered material at $T_a \approx 510$°K three stages of effects have been observed. In the first, the f.c.c. phase converts to a highly ordered CsCl-type structure, the magnetization at T_a increasing with a time constant of ≈10 minutes; the material is strongly ferromagnetic down to low temperatures. In the second stage, there is a much slower ($\tau \approx 400$ minutes) increase in magnetization at T_a with a gradual return of the first-order transition at lower temperatures. In the third stage, there is no further increase in magnetization at T_a but the first-order transition continues to increase in completeness and sharpness. Author

N67-34704* Arizona Univ., Tucson. Engineering Experiment Station.
DYNAMIC MEASUREMENTS OF THE ELECTRICAL PROPERTIES OF METAL OXIDES IN HIGH RADIATION FIELDS AT HIGH TEMPERATURES Final Report, 1 Sep. 1966–28 Feb. 1967
Monte V. Davis 28 Feb. 1967 10 p refs
(Grant NGR-03-002-056)
(NASA-CR-87812) CSCL 20L

Continuing and completed research are briefly mentioned. Measurements of the temperature dependent electric conductivity of aluminum, beryllium, thorium, and zirconium oxides are reported finished. Models for interpreting the data are indicated, and reference is made to the voltage breakdown measurements in Lucalox. The program results are summarized in tabular and graph form. N.E.N.

N67-34740*# Stanford Univ., Calif. Solid-State Electronics Lab.
TRANSITION METAL IMPURITIES IN SEMICONDUCTORS
J. W. Allen and G. L. Pearson Jun. 1967 70 p refs
(Grant NsG-555)
(NASA-CR-87816; SEL-67-060; TR-5115-1) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The deep-lying energy levels produced by transition metal impurities in semiconductors are of considerable technological importance. Hitherto they have been treated by empirical means. Application of crystal field theory to the impurity problem is considered and it is shown that we can now begin to understand the behavior of the $3d^n$ impurities in atomic rather than phenomenological terms. Some definitions concerning energy levels in a multielectron impurity are laid down. A survey of atomic structure and crystal field theory is given. The aim is to introduce the concepts and the notation, rather than to give full derivations of standard results. By using optical absorption into excited states of the d-shell, together with the usual methods of investigation of semiconductors or phosphors, it is possible to establish the electronic configuration of the impurity. Investigations of transition metals in II–VI and III–V compounds illustrate the sort of result obtained. One simple application is the interpretation of luminescent transitions in such centers. Once the electronic configurations have been established, one can calculate the energy levels. As examples, published data on ZnS and GaAs are interpreted, and the energy levels of some impurities not yet investigated are predicted. Other properties may also be determined, and as an example a calculation of the photoionization spectrum is outlined. Author

N67-34742# International Union of Pure and Applied Chemistry, Basle (Switzerland). Commission on High Temperatures and Refractories.
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE. VOLUME 1967, NO. 2: APR., MAY, JUN. 1967
J. J. Diamond (Natl. Bur. of Std., Washington, D. C.) [1967] 70 p refs Prepared in cooperation with Natl. Bur. of Std.
Available from Natl. Bur. of Std., Washington, D. C.

A bibliography on the high temperature chemistry and physics of materials in the condensed state is presented in which are cited studies of the following: (1) devices for achieving temperatures above 1500°C; (2) devices for measuring and controlling temperatures above 1000°C; (3) devices for physical measurements at temperatures above 100°C; (4) properties, at temperatures below 1000°C, of metallic and nonmetallic materials which melt above 1500°C; (5) properties, at temperatures above 1000°C, of materials (metallic, nonmetallic, and mixed) which melt above 1500°C; (6) properties, at temperatures above 1000°C, of metallic and nonmetallic materials which melt below 1500°C; (7) phase equilibria; and (8) reactions at temperatures above 1000°C. Also cited is a list of books published in this area. S.C.W.

N67-34961# Polytechnic Inst. of Brooklyn, N. Y.
INTERPRETATION OF THE OPTICAL SPECTRUM OF Yb^{3+} IN CdF_2
Victor J. Abbruscato (Ph.D. Thesis) Jun. 1967 81 p refs
(Contract DA-31-124-ARO(D)-71)
(TR-2; AROD-3948.2-C; AD-654047) CFSTI: HC $3.00/MF $0.65

The optical absorption spectra of Yb(3+) in CdF2 and of Yb(3+) in CdF2 in the presence of various co-dopants such as Na(+), Y(3+), and Eu(3+) were recorded and the oscillator strengths of the main absorptions of the Yb(3+) in the 10,000/cm region were calculated. Also, the Electron Spin Resonance (ESR) spectra of Yb(3+) in CdF2 and Yb(3+) in CdF2 in the presence of Na(+), 2% Y(3+) and 10% Y(3+) were recorded. Non-cubic spectra were observed only in the case of the Yb(3+) -Na(+) -CdF2 and Yb(3+) -10% Y(3+) -CdF2 samples. The former non-cubic spectrum was interpreted assuming a rhombic distortion with the

major distortion axis along the 110 direction, while the latter could not be interpreted due to the broadness of the absorptions. From the results of these measurements and the comparison to the optical spectra of Yb(3+) in other systems, it has been concluded that the previous interpretation of the optical spectrum of Yb(3+) in CdF2 is incorrect. It is the contention of this thesis that the main absorption line at 10,250/cm is not due to an internal f-f transition but is due to some other mechanism. Possible mechanisms are proposed based on some of the unusual physical properties of trivalent rare earth ions in CdF2. Author (TAB)

N67-34967 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THE STUDY OF LOW ANGLE BOUNDARIES IN LARGE SINGLE CRYSTALS OF ZINC [BADANIA NISKOKATOWYCH GRANIC W DUZYCH MONOKRYSZTALACH CYNKU]
Antoni Modrzejewski and Stanislaw Szarras Sep. 1965 20 p refs
(INR-663/II/PS)

Low angle boundaries in large single crystals of zinc grown by the BRIDGMAN method were studied by means of neutrons and X-rays. The neutron rocking curves obtained from the crystals containing this type of substructure are shown to depend on the position of the crystal with reference to the neutron beam. X-ray studies have proved that the rotation axes of mutually disoriented subgrains lie nearer to the basal plane (0001) than to the crystal axis. Author

N67-34988# Oak Ridge National Lab., Tenn. Health Physics Div.
OPTICAL PROPERTIES OF SODIUM IN THE VACUUM ULTRAVIOLET
J. C. Sutherland (Ph.D. Thesis—Ga. Inst. of Tech.), R. N. Hamm, J. R. Stevenson, and E. T. Arakawa May 1967 126 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1776) CFSTI: HC $3.00/MF $0.65

An experiment was carried out to extend the measurements of the optical constants of sodium into the vacuum-ultraviolet region of the spectrum, and to compare the optical constants measured in this region with those measured in the near-ultraviolet, visible, and infrared regions, with the results of electron-energy-loss experiments, and with current theories of the optical properties of metals. NSA

N67-35014# General Electric Co., Schenectady, N. Y.
THE INTERMEDIATE STATE IN TYPE I SUPERCONDUCTORS
J. D. Livingston and W. De Sorbo Sep. 1966 44 p refs
(Rept.-66-C-328)

This report reviews the extensive literature on the intermediate state of semiconductors. A variety of techniques have been used for the direct observation of intermediate state structures. Results of these observations are reviewed, as are theories of the intermediate state, and magnetic, electrical, and thermal properties of materials in the intermediate state. The relation between the intermediate state and mixed state is discussed. Author

N67-35140 Lockheed Missiles and Space Co., Palo Alto, Calif.
ELECTROPHYSICAL PROPERTIES OF THE InBi COMPOUND
M. A. Krivov, E. V. Malisova, and V. A. Presnov [1967] 3 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk), no. 6, 1967 p 152–154

A plot showing the temperature dependency of the conductivity of InBi samples shows that the material possesses high conductivity ($\approx 10^4$ ohm^{-1} cm^{-1}) which diminishes slightly as the temperature rises. The Hall constant has the value of $\approx 5 \times 10^{-3}$ cm^3/coulomb, and does not change in the investigated temperature range. The current carrier concentration is $\approx 10^{21}$ cm^{-3}, and the mobility drops from ≈ 150 cm^2/v-sec to ≈ 50 cm^2/v-sec as the temperature rises. A plot of showing the temperature dependence of the thermal emf coefficient for three samples is also presented. The magnitude of the coefficient at room temperature changes from 5 to 25 microvolts per degree in the different samples, and increases slightly as the temperature rises. One other plot is presented showing the typical heat conduction dependence on temperature for InBi single crystals. The heat conduction diminishes as the temperature rises in the 140°–190°K range and then starts to increase. This ascending branch may be associated with the electron heat transfer. L.S.

N67-35199 Technische Hochschule Munchen (West Germany). Fakultaet fuer Allgemeine Wissenschaften.
ELECTROLUMINESCENCE INVESTIGATIONS ON ZnS VAPOR DEPOSITED FILMS AND ZnS CRYSTALS [ELETROLUMINESZENY-UNTERSUCHUNGEN AN ZNS-AUSDAMPFSCHICHTEN UND ZNS-KRISTALLEN]
Guenter Zollfrank (Ph.D. Thesis) 1967 80 p refs In GERMAN

Electroluminescent characteristics of evaporated zinc sulfide layers and crystals doped with manganese and copper were studied for their distribution and time dependency to applied voltage, frequency fields, and temperature. It was observed that electroluminescence appeared in both, zinc sulfide layers and zinc sulfide crystals, when the current-voltage characteristics were non-linear; luminescent intensity of the manganese clusters increased with increased voltage and temperature in contrast to the included copper impurities. Transl. by G.G.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N67-34203# Cornell Aeronautical Lab., Inc., Buffalo, N. Y. Hypersonic Facilities Dept.
SIMULATION OF EARTH-STORABLE LIQUID PROPELLANTS WITH GASEOUS REACTANTS
W. Sheeran Jun. 1967 21 p refs Supersedes AHRD-PS-65-8
(HFD-PS-67-5; AHRD-PS-65-8)

From thermodynamic considerations it was shown that to exactly duplicate the combustion products of earth-storable liquid propellants, a gaseous fuel/oxidizer combination at the same initial temperature must have the same atomic composition and initial energy as the liquid propellant mixture. On the basis of these two requirements, a gaseous reactant combination of $N_2/O_2/H_2/C_2H_4$ was determined which, when combusted, was shown through the usual equilibrium composition calculations to duplicate the exhaust products and temperature from the combustion $N_2O_4/50/50N_2H_4$–UDMH liquid propellants. Author

N67-34335# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
PLASMA CYCLOTRON ECHOES
Thomas B. Smith 1 Jun. 1967 35 p refs
(Contract DA-28-043-AMC-02536(E))
(RLE-TR-458; AD-654026) CFSTI: HC $3.00/MF $0.65

The paper contains a single-particle model that is sufficient to explain observed radiation peaks from weakly ionized laboratory

plasma immersed in a magnetic field subsequent to one, two or three short driving RF pulses at the gyro frequency. It is shown that, depending upon the regime of operation, these echoes can result from any combination of arbitrary speed dependences in the gyro frequency, collision frequency, or diffusion of the electrons between and after the pulses. Author (TAB)

N67-34912*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
HANDBOOK OF PHYSICAL AND THERMAL PROPERTY DATA FOR HYDROGEN. TRIPLE POINT REGION TO CRITICAL POINT REGION. VOLUME I: A STUDY OF HYDROGEN SLUSH AND/OR HYDROGEN GEL UTILIZATION
11 Mar. 1967 72 p refs
(Contract NAS8-20342)
(NASA-CR-87655; LMSC-K-11-67-1, Vol. I) CFSTI: HC $3.00/MF $0.65 CSCL 21I

Physical and thermal property data for hydrogen in the regions between the triple point and the critical point are tabulated and illustrated in both the English and International systems of units in this handbook for space vehicle designers. Nearly all of the data presented are for parahydrogen, since this is the major component of low temperature equilibrium mixtures. Properties, such as the solubility of helium in hydrogen, that are significantly different for parahydrogen and orthohydrogen are presented for the case of equilibrium mixtures. Property data in the solid, liquid, and vapor states near the triple point temperature of 13.803°K (24.85°R) were taken from this handbook for a hydrogen slush utilization study. M.W.R.

N67-35223*# Atlantic Research Corp., Alexandria, Va. Research Div.
A STUDY OF ENERGY RELEASE IN ROCKET PROPELLANTS BY A PROJECTILE IMPACT METHOD
Annual Report, 9 May 1966–9 May 1967
Andrej Maček and Robert L. Durfee 9 Jun. 1967 33 p refs
(Contract NAS1-6200)
(NASA-CR-66395; AR-1) CFSTI: HC $3.00/MF $0.65 CSCL 21I

Experimental measurement of the rates of energy release in solid propellants subjected to strong shock waves is studied by impacting a propellant sample by a high-velocity projectile fired from a gun in such a way that both the amplitude and the duration of the shock wave are known and controllable over an appreciable range. A successful method has been developed for non-destructive collection of the sample after the passage of the shock wave, and the shocked partly reacted samples have been chemically analyzed for the extent of reaction which occurred under exposure to known shock waves. Problems attending the generation of controlled shock waves and the non-destructive recovery are discussed in some detail. The materials studied were pressed samples of pure granular ammonium perchlorate and pressed mixtures of ammonium perchlorate/polyethylene powders. The upper limit of shock amplitudes studied has been about 20 kbar and the shock durations were in the range of about 10 to 20μsec. The quantitative decomposition data on ammonium perchlorate are consistent with a model of high-pressure surface burning of individual grains in the pressed sample, in which only a certain fraction of the total grain area is ignited by the shock wave. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N67-34218* Multi-Tech, Inc., San Fernando, Calif.
COMBUSTION PROCESSES IN A BIPROPELLANT LIQUID ROCKET ENGINE—A CRITICAL REVIEW
Frank B. Cramer and Philip D. Baker Pasadena, Calif., JPL, 15 Jan. 1967 399 p Prepared for JPL
(Contracts NAS7-100; JPL-950926)
(NASA-CR-87654) CSCL 21B

The literature on liquid rocket engine combustion processes is reviewed and critically evaluated. The body of current information forces one to the conclusion that the current widely accepted one-dimensional drop evaporation limited model is inadequate and that a much more complex description of the combustion process must be developed. On the other hand, within the framework of existing knowledge, it is not possible to treat stable combustion and include all details of the following broad areas: 1) Injection and Stream Break-up—as processes controlled by the interaction of stream hydrodynamics and the aerodynamic environs and occurring in a manner which is non-uniform in time and space. 2) Drop Mass and Positional History, and 3) The acceleration and mixing processes driven by the system's thermodynamics and non-uniformities. Thus, any attempt to assemble a comprehensive model must, at this point in time, include more assumption than established relations. A summary of major information gaps that must be filled prior to formulating a reasonable combustion model is included in this review. Author

N67-34242*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EVALUATION OF AN ION PROPULSION SYSTEM FOR A SYNCHRONOUS SPACECRAFT MISSION
Kenneth I. Duck, Robert O. Bartlett, and Robert J. Sullivan Aug. 1967 14 p refs Presented at the AIAA Elec. Propulsion and Plasmadyn. Conf., Colorado Springs, 11–13 Sep. 1967
(NASA-TM-X-55874; X-734-67-382) CFSTI: HC $3.00/MF $0.65 CSCL 21C

A six-degree-of-freedom mathematical model was used in conjunction with a hybrid computer and an energy management–power system simulator. The simulation included the effects of (1) triaxial earth, (2) sun and moon perturbations, (3) real thruster characteristics, (4) solar radiation pressure, (5) gravity gradient torque, and (6) thrust beam vectoring. Results indicate that the optimum thruster combination is composed of four beam vectored modules, three of which are in continuous operation. An ion propulsion system was evaluated for a large communications spacecraft with regards to propulsion system weight, peak power requirement, average power requirement, thrust level, moment arm, and attitude duty cycle. Problem areas of thrust beam impingement and obtaining a large enough moment arm to minimize the thrust level, attitude duty cycle, and, consequently, power requirement, are discussed. The analysis allows one to perform a preliminary total system sizing of an ion propulsion system for a synchronous mission. Author

N67-34300*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE APPLICATION OF ELECTRIC PROPULSION TO SATELLITE ORBIT ADJUSTMENT AND STATION KEEPING
Curtiss C. Barrett Aug. 1967 15 p refs Presented at the AIAA Elec. Propulsion and Plasmadyn. Conf., Colorado Springs, Colo., 11–13 Sep. 1967
(NASA-TM-X-55980; X-734-67-400) CFSTI: HC $3.00/MF $0.65 CSCL 21C

Satellite orbit adjustment and station keeping can be accomplished by electric propulsion systems. The systems considered in this study are those which are limited to thrust levels of a few millipounds. These thrust levels result in relatively slow variation of the state variables, and therefore the equations of motion lend themselves quite well to perturbation techniques of solution. Under

these conditions the use of electric propulsion for orbit adjustment and station keeping and attitude control of typical earth-synchronous and sun-synchronous satellites has been studied. For a sun-synchronous meteorological satellite it was found that a five millipound resistojet system under continuous thrust application could correct an orbit precession error of 0.029 degrees per day by a spiralling operation lasting 11.3 days. It was found that the method of inclination adjustment and constantly balancing the precession moment were less efficient than the spiralling approach. For a 1400 pound earth-synchronous communications satellite a five pound hydrazine system was assumed for removal of gross injection errors. A 17.4 millipound resistojet was employed for vernier orbit adjustment of 22 feet per second which required 26 days. A self optimizing adaptive technique was assumed for attitude control using a multijet module system. Author

N67-34456# California Univ., Berkeley.
FINITE ELEMENT ANALYSIS FOR SOLID ROCKET MOTOR CASES
Leonard R. Herrmann, Robert L. Taylor, and David R. Green (Glascow Univ.) Mar. 1967 45 p refs Prepared for Stanford Res. Inst.
(Contract N123(60530)-55641A)
(Rept.-67-4; AD-653750) CFSTI: HC $3.00/MF $0.65

A finite element development for shells of revolution and cylinders in plane strain is presented. The element is based upon a variational theorem which allows linear displacement expansions in each element, thus, an element is developed which is fully compatible with commonly employed continuum elements. A numerical example is presented along with a computer program listing for shells of revolution. Author (TAB)

N67-34473# Oklahoma City Air Materiel Area, Tinker AFB, Okla.
PAPER 1—EDDY CURRENT INSPECTION OF TURBOJET ENGINE TURBINE DISKS FOR LOSS OF STRENGTH
Lawrence G. Marler *In* Army Mater. Res. Agency Defense Conf. on Nondestructive Testing 1966 p 49–55 (See N67-34467 20-15)

The use of eddy currents to detect a reduction in the strength of a material after repeated exposure to temperature and stress is reported. Effort was directed toward nondestructively determining the material strength loss generated by J-47 engine turbine disks failure. The J-79 engine turbine disks currently being tested are used in the F-4 and B-58 aircraft, and have a monolithic structure of A286. This non-magnetic alloy is corrosion and heat resistant. R.L.I.

N67-34800*# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
AXIAL MODE SHOCK WAVE COMBUSTION INSTABILITY IN LIQUID PROPELLANT ROCKET ENGINES
Charles E. Mitchell Jul. 1967 203 p refs
(Contract NASr-217; Grants NaG-99-60; NSF GP-579)
(NASA-CR-72259; AMS-TR-798) CFSTI: HC $3.00/MF $0.65
CSCL 21B

Axial mode combustion instability in liquid rocket combustors is investigated, analytically, with the combustion processes represented using the Crocco time-lag concept. Periodic oscillations of finite amplitude, both continuous and discontinuous in form, are studied. Two types of combustion distribution are considered. The first is the limiting case where the combustion can be taken to be concentrated at the injector face. The second occurs when the combustion is sufficiently distributed so that the derivative of the steady-state velocity is of the same order as the steady-state velocity itself. For either type of combustion distribution both continuous and discontinuous pressure waves are predicted for values of the combustion feedback parameters that are in the range of practical interest. Small amplitude continuous oscillations are found to exist near the stability limit predicted by previous linear analyses. Larger amplitude discontinuous, shock-type oscillations are found at larger displacements into the region of linear instability. Discontinuous oscillations are also found for some values of the combustion parameters for which linear stability is predicted. In this latter case the periodic discontinuous oscillations are considered to be the form that oscillations take when triggered by a finite amplitude disturbance. Author

N67-34803# Aeronautical Research Labs., Melbourne (Australia).
DEVELOPMENT OF A TOXIFYING AFTERBURNER FOR DIESEL ENGINES
T. S. Keeble, D. R. Warren, and W. H. Schofield Jan. 1966 29 p refs
(ARL/ME-272)

An afterburner for a Diesel tractor has been developed which produces at all engine conditions an exhaust gas suitable for use in rabbit extermination. The original burner was designed to burn diesel oil, but subsequent tests showed that traces of unburnt diesel oil from the afterburner broke the foam used in rabbit extermination. The final burner was therefore designed to burn methylated spirits which does not break the foam. The experimental unit has been redesigned in a form suitable for limited batch production. Author

N67-34768*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOLID PROPELLANT ENGINEERING
In its Space Programs Sum. No. 37–45, Vol. IV 30 Jun. 1967 p 71–91 refs (See N67-34761 20-30)

The Applications Technology Satellite (ATS) motor development is discussed in terms of weight and measurement data on the ATS apogee motor storage units; the design and release mechanism evaluation of an omnidirectional antenna; and the flight motor storage and surveillance program. Experiments were conducted on acid anhydride–epoxide and acid anhydride–aziridine reactions in efforts to define curing reactions and a model system for use in determining prepolymer functionality. Results indicate that while these reactions could conceivably be used for binder curing, the problems associated with these systems make them less practical than existing curing reactions. Side-force numerical integrations over the nozzle and pintle surface are reported for the pintle nozzle thrust vector control system. To assess the importance of the pressure oscillation rate of depressurization on low pressure combustion extinction, data on low frequency instability and extinguishment data for five propellants were reduced. Figures depict the pressure oscillation frequency versus mean chamber pressure for each. M.G.J.

N67-34770*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROPULSION RESEARCH AND ADVANCED CONCEPTS
In its Space Programs Sum. No. 37–45, Vol. IV 30 Jun. 1967 p 129–177 refs (See N67-34761 20-30)

Performance evaluation data are given on the fabrication and component testing of the NaK–N_2 conversion system, and on high temperature tests of a superalloy containment material, for a nonrotating Rankine cycle liquid metal magnetohydrodynamic system. Results are included on a first order evaluation of reactivity effects from fuel displacement in a small thermionic reactor. Four methods used to evaluate the enthalpy of the high temperature internal flow of argon are compared: conservation of energy, a calorimetric probe, a flowmeter, and spectroscopy. The energy balance and calorimetric probe were found to apply for both nonequilibrium and equilibrium flows. Equations are derived for use in analog simulation to predict stability criteria, transients, and transfer functions of a small liquid metal-cooled space thermionic

converter. An experimental investigation of the effects of pressure and a transverse subsonic gas velocity on a glow discharge structure between parallel electrode surfaces showed that pressures ranged between 50 and 200 mm Hg, and argon gas velocities between 80 and 220 ft/s. Swirling argon gas and water flows were used as test apparatus to assess the influence of a sharp 90° turn on the motion of a swirling fluid. M.G.J.

N67-34771*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LIQUID PROPULSION
In its Space Programs Sum. No. 37-45, Vol. IV 30 Jun. 1967 p 179-196 refs (See N67-34761 20-30)

As part of the advanced liquid propulsion systems development program, expulsion cycling and slosh testing were conducted on composite bladder materials fabricated from Teflon film, Teflon felt, and aluminum foil. The results show that bladders made from these composites can be expected to have a very slightly lower expulsion efficiency than ordinary TFE-FEP bladders, but their cycle will be longer. However, slosh damping and liquid surface control show a marked improvement over the conventional bladders. A fill valve, with three different construction materials, is discussed briefly. The combustion behavior of a resonant combustion injector is examined to establish steady state performance, and configuration modifications are described. Single element unlike impinging-sheet injectors with a jet diameter of 0.33 in. were built and fired with N_2O_4/N_2H_4 in a series of experiments designed to detect and measure the extent of propellant stream separation. The results are compared with previous data for both jets and sheets in terms of the critical stream dimension. M.G.J.

N67-34903 Bristol Siddeley Engines, Ltd. (England). Small Engine Div.
AIR CLEANERS FOR SMALL GAS TURBINES IN HELICOPTERS AND HOVERCRAFT
R. R. A. Fricker Feb. 1966 24 p refs
(EE-4455)

The requirements for air cleaners for helicopters and hovercraft are discussed and a minimum efficiency curve for helicopter applications is suggested. Possible methods of removing dust from air are described and evaluated in relation to this requirement, and the conclusion is drawn that only fibrous filters and inertial separators are practical propositions, with inertial separation as the more attractive solution. The theory of inertial separators is discussed and a simple approximate formula for size of particle separated is presented. The conclusion is reached that multi-tube designs of vortex separator are needed to meet efficiency requirements. Author

N67-34988*# Hughes Research Labs., Malibu, Calif.
HIGH-TEMPERATURE LIQUID-MERCURY CATHODES FOR ION THRUSTERS Quarterly Progress Report, 1 Dec. 1966-28 Feb. 1967
K. W. Arnold, W. O. Eckhardt, G. Hagen, J. A. Snyder, and R. C. Knechtli 28 Feb. 1967 61 p refs
(Contract NASw-1404)
(NASA-CR-87500; QPR-3) CFSTI: HC $3.00/MF $0.65 CSCL 21C

Relationships between various cathode parameters were derived for a high temperature liquid mercury cathode; and the thermal resistance of the cathode between the pool and the thermocouple location was calculated for both circular and annular pool geometries. The substantially lower thermal resistance for the latter case is clearly shown. Heat rejection from the cathode to the thruster was estimated for a number of geometries to select a particular configuration combining good heat conduction with low weight. Test results of a normalized parameter for a vapor fed cathode are included in a table. Work performed on an LM neutralizer cathode; and experiments performed with cathode No. 25-II in the 15-cm permanent magnetic configuration thruster, are described. Another series of experiments in which a probing baffle carrying both a small pinhole and a narrow slot was used to investigate the contribution per unit area of the cathode vapor cone region to the formation of ions in the discharge chamber, are also discussed. L.S.

N67-35008*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DESIGN AND PERFORMANCE OF THERMAL STORAGE RESISTOJET
Robert N. Gibson, Jr. and Thomas A. Cygnarowicz Aug. 1967 13 p refs Presented at the AIAA Elec. Propulsion and Plasmadyn. Conf., Colorado Springs, 11-13 Sep. 1967
(NASA-TM-X-55884; X-736-67-388) CFSTI: HC $3.00/MF $0.65 CSCL 21C

A thermal storage resistojet designed and tested for possible satellite applications is discussed. It uses an electrical resistance element to heat ammonia propellant. The mechanical design is based on a modular concept incorporating three modules: heating element, thruster body and heat shield package. Hardware interchangeability, integrity and ease in design alterations for performance changes are noted. The thruster is a flange mounted cylinder two inches in diameter and 5 inches long. Performance testing for the resistance jet is done at both steady state and transient conditions. Pulse mode tests were conducted to simulate satellite applications. Environmental tests included vibration, acceleration and thermal vacuum. Author

N67-35122*# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
NONLINEAR ASPECTS OF COMBUSTION INSTABILITY IN LIQUID PROPELLANT ROCKET MOTORS Status Report, 1 Jun. 1966-31 May 1967
L. Crocco, D. T. Harrje, W. A. Sirignano, F. V. Bracco, C. E. Mitchell, P. K. Tang et al Jun. 1967 155 p refs
(Contract NASr-217)
(NASA-CR-72270; AMS-SR-553-g; AR-7) CFSTI: HC $3.00/MF $0.65 CSCL 21B

Both theoretical and experimental investigations are being conducted on the problem of combustion instability in liquid propellant rocket engines, with emphasis on the nonlinear aspects of the problem. The theoretical research is concentrating on studies of possible mechanisms of combustion instability such as droplet burning, the nonlinear gas dynamic oscillations associated with combustion instability involving shock-type waves in both the tangential and longitudinal modes, the effect of damping devices on stability with emphasis on nonlinear effects associated with acoustic liners, and fundamental studies of the basic energy sources. The experimental program includes basic experiments designed to study various phases of combustion and/or the instability phenomena in rocket engines and cold chambers to provide information for constructing theoretical models. It also includes studies of the effects of exhaust nozzles and damping devices on the instability as well as controlled testing of liquid rocket engines with parametric variations intended to determine the factors which affect the incidence of nonlinear combustion instability. R.N.A.

N67-35190*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DESIGN AND DEMONSTRATION OF A RADIOISOJET
R. Viventi, Jr. and W. C. Isley Aug. 1967 10 p Presented at the AIAA 3d Propulsion Joint Specialist Conf., Washington, D. C., 17-21 Jul. 1967
(NASA-TM-X-55883; X-734-67-379) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The development and evaluation of the performance of a radioisotope heated thruster suitable for possible spacecraft application is discussed. A Pm-147 oxide capsule was used as the source of heat in an ammonia thruster. The mechanical design of the thruster was based on that of the thermal storage resistance jet. Measurements were made of thrust, propellant mass flow, and temperature transients during a continuous two-week test program. Correlation with an electrically heated unit was excellent. Thruster performance parameters were measured over the full range of duty cycle and as a function of propellant flow rate. The results were found to correlate with duty cycle. Application of the radioisojet to a number of missions has been considered. Author

N67-35249# Italy. Ministero Difesa Aeronautica, Rome.
CRITICAL EXAMINATION OF THE PULSEJET [STUDIO CRITICO DEL PULSOREATTORE]
Rodolfo Pallabazzer 1966 25 p refs In ITALIAN; ENGLISH summary
(Rept.-27) CFSTI: HC $3.00/MF $0.65

A critical reexamination of the pulsejet from the thermodynamical and geometrical standpoint is developed. On the basis of results and achieved experiences, it has been possible to single out several suggestions leading to the study of certain new geometries by means of the theory of characteristics. This study is comparative and supplies new ideas for the definition and improvement of two new kinds of pulsejets with afterburner and double exhaust. Author

N67-35250 Technische Hochschule Stuttgart (West Germany). Arbeitsgemeinschaft fuer Raketentechnik und Raumfahrt.
ABLATIVE COOLING OF A GFK ROCKET COMBUSTION CHAMBER WITH RADIALLY SYMMETRICAL FIBER FLOW [ABLATIV GEKUEHLTE GFK-RAKETENBRENNKAMMERN MIT RADIALSYMMETRISCHEN FASERVERLAUF]
Herbert Zehlein Apr. 1966 72 p refs In GERMAN

A graphic-mathematical method is presented for determining the glass content distribution of a structure in dependence of the fiber distribution. The method also permits solution of such a problem in reverse, i.e., fiber distribution requirements for a given glass content distribution, and it furthermore indicates whether or not a solution exists. The dimensions of the pressed structure are dejived from the fiber windings. The relationship of all applicable parameters is formulated. Diagrams are used to summarize the results and to form the theoretical base for the design. Practical application of the method is demonstrated. Transl. by K.W.

N67-35259 Bolkow Entwicklungen K. G., Munich (West Germany).
ABOUT ROCKET TRANSMISSION AND GAS GENERATOR WITH HYDRAZINE AS MONERGOL [UEBER RAKETEN-TRIEBWERKE UND GASERZEUGER MIT HYDRAZIN ALS MONERGOL]
Helmut Hopmann 1967 38 p In GERMAN Presented at the DGRR Symp. on Chem. Rocket Transmission, Munich, 21 Mar. 1967
(TR-714-O; Rept.-67-010)

A brief survey on the advantages and disadvantages in optimal utilization of hydrazine as monergol rocket fuel is given. The most important hydrazine efficiency values for rocket technology and gas generators are presented and followed by a description of the catalytic decomposition and gas producing processes. Transl. by G.G.

N67-35260 Bolkow Entwicklungen K. G., Munich (West Germany).
REPORT ABOUT THE DEVELOPING WORK ON A 30-KP-LIQUID HYDROGEN/LIQUID OXYGEN TRANSMISSION [BERICHT UEBER DIE ENTWICKLUNGSARBEITEN AN EINEM 30 KP-FLUSSIGWASSERSTOFF/FLUSSIG-SAUERSTOFF TRIEBWERK]
Albert Seidel 1967 47 p refs In GERMAN Presented at the DGRR Symp. on Chem. Rocket Transmission, Munich, 21 Mar. 1967
(TR-713-O; Rept.-67-008)

Described is the development of the 30 kp-LH_2/LO_2 rocket motor from theoretical considerations to construction of a prototype for flight simulation. Design and construction of the test stand and of facilities for fuel development and support are discussed. Test stand performance of the engine is covered, and experiments with hydrogen fluorine engines are briefly described. Transl. by K.W.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N67-34141# European Space Research Organization, Paris (France).
AURORAL AND ASSOCIATED MAGNETOSPHERIC PHENOMENA AT VERY HIGH LATITUDES
Aug. 1966 434 p refs Proc. of ESRO Colloq., Stockholm, 16–18 Nov. 1965
(ESRO-SP-8) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. ON THE IMPORTANCE OF ELECTRIC FIELDS IN THE MAGNETOSPHERE AND INTERPLANETARY SPACE H. Alfven (Royal Inst. of Tech.) p 1–13 refs (See N67-34142 20-29)

2. MAGNETIC STORM EFFECTS ASSOCIATED WITH THE TAIL OF THE MAGNETOSPHERE W. I. Axford (Cornell Univ.) p 15–27 refs (See N67-34143 20-29)

3. NEUTRAL POINTS ON THE BOUNDARY OF THE CLOSED MAGNETOSPHERE G. D. Mead (NASA, Goddard Space Flight Center) p 33–42 refs (See N67-34144 20-29)

4. RECENT MEASUREMENTS OF THE MAGNETIC FIELD IN THE OUTER MAGNETOSPHERE AND BOUNDARY REGIONS J. P. Heppner (NASA, Goddard Space Flight Center) p 43–89 refs (See N67-34145 20-29)

5. DESIRABLE MAGNETIC FIELD MEASUREMENTS IN THE HIGH-LATITUDE MAGNETOSPHERE R. Bostroem (Royal Inst. of Tech.) p 91–101 refs (See N67-34146 20-29)

6. COUPLING BETWEEN THE OUTER MAGNETOSPHERE AND THE HIGH LATITUDE IONOSPHERE L. P. Block (Royal Inst. of Tech.) p 105–124 refs (See N67-34147 20-29)

7. A DYNAMICAL MODEL OF AURORAL MORPHOLOGY R. N. DeWitt and S. I. Akasofu (Alaska Univ.) p 125 150 refs (See N67-34148 20-13)

8. MEASUREMENT OF ELECTRIC FIELDS IN THE IONOSPHERE AND MAGNETOSPHERE R. L. F. Boyd (Univ. Coll.) p 155–166 refs (See N67-34149 20-13)

9. THEORY OF ELECTRIC FIELD MEASUREMENTS CONDUCTED IN THE MAGNETOSPHERE WITH ELECTRIC PROBES U. Fahleson (Royal Inst. of Tech.) p 167–206 refs (See N67-34150 20-13)

10. RECENT RESULTS FROM SATELLITE MEASUREMENTS OF LOW-ENERGY PARTICLES PRECIPITATED AT HIGH LATITUDES J. E. Evans, R. G. Johnson, R. D. Sharp, and J. B. Reagan (Lockheed Missiles and Space Co.) p 209–234 refs (See N67-34151 20-29)

11. ENERGETIC PARTICLE OBSERVATIONS FROM IMP SATELLITES P. Rothwell (Southampton Univ.) p 235–247 refs (See N67-34152 20-29)

12. SUGGESTIONS FOR MAGNETOSPHERIC EXPERIMENTS J. J. Quenby (Imperial Coll. of Sci. and Tech.) p 251–257 refs (See N67-34153 20-30)

13. PARTICLE MEASUREMENTS ON AN ESRO SATELLITE (NEUTRAL 1) IN A HIGHLY-ECCENTRIC POLAR ORBIT B. J. O'Brien (Rice Univ.) p 259–277 refs (See N67-34154 20-29)

14. POSSIBLE PARTICLE MEASUREMENTS IN THE HIGH LATITUDE MAGNETOSPHERE R. A. Hoffman (NASA. Goddard Space Flight Center) p 279–298 refs (See N67-34155 20-29)

15. VLF AND ELF WAVES IN THE MAGNETOSPHERE L. Harang (Oslo Univ.) p 299–439 refs

N67-34142# Royal Inst. of Tech., Stockholm (Sweden).
ON THE IMPORTANCE OF ELECTRIC FIELDS IN THE MAGNETOSPHERE AND INTERPLANETARY SPACE
H. Alfven *In* ESRO Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes Aug. 1966 p 1–13 refs (See N67-34141 20-29)

In order to understand the properties of the magnetosphere it is necessary to know both the magnetic and electric fields. As very few measurements of electric field have yet been made, the discussion is confined to a survey of current theories on interplanetary space and on magnetosphere. Biermann's theory concerning the solar corpuscular radiation emission, the solar co-rotation, the solar magnetic field are reviewed as well as the theory concerning the magnetosphere, i.e. electric field and auroral electrojets. ESRO

N67-34143*# Cornell Univ., Ithaca, N. Y.
MAGNETIC STORM EFFECTS ASSOCIATED WITH THE TAIL OF THE MAGNETOSPHERE
W. I. Axford *In* ESRO Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes Aug. 1966 p 15–27 refs (See N67-34141 20-29)
(Grant NsG-382) CSCL 08N

In the interaction of solar wind with the magnetosphere, the ion gyro-radius of the order of 10^7–10^8cm and the Debye length about 10^3cm, which are both small in comparison with the characteristic dimension of the magnetosphere (10^{10}cm). A fluid description of the gross aspects of the interaction is appropriate since it leads to a self-consistent treatment, and allows the use of well-established results from the aerodynamics. The effects of dissipative processes which take place in the bulk of the fluid are considered as well as the effects of these processes occurring in boundary layers at the interface between the solar wind and the magnetosphere. The phenomenon of energy dissipation during magnetic storms is reviewed. Finally the conversion of magnetic energy arising from the energy of the solar wind in the tail of the magnetosphere is analyzed. ESRO

N67-34144*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NEUTRAL POINTS OF THE BOUNDARY OF THE CLOSED MAGNETOSPHERE
Gilbert D. Mead *In* ESRO Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes Aug. 1966 p 33–42 refs (See N67-34141 20-29) CSCL 08N

In order to obtain solutions to the problem of determining the shape of the boundary between a streaming plasma and a magnetic dipole a number of simplifying assumptions have been made. The most important is that the plasma is completely field-free and at zero temperature, so that the dipole field becomes quite enclosed. This leads to a closed model of the magnetosphere. A number of results of these studies is reviewed with emphasis upon the shape of the boundary and the topology of magnetic fields in the vicinity of the neutral points. ESRO

N67-34145*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RECENT MEASUREMENTS OF THE MAGNETIC FIELD IN THE OUTER MAGNETOSPHERE AND BOUNDARY REGIONS
J. P. Heppner *In* ESRO Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes Aug. 1966 p 43–89 refs (See N67-34141 20-29) CSCL 08N

Measurements of the magnetic field in the outer magnetosphere and boundary regions obtained by IMP-I and OGO-A satellites are presented. ESRO

N67-34146# Royal Inst. of Tech., Stockholm (Sweden).
DESIRABLE MAGNETIC FIELD MEASUREMENTS IN THE HIGH-LATITUDE MAGNETOSPHERE
R. Bostroem *In* ESRO Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes Aug. 1966 p 91–101 refs (See N67-34141 20-29)

Among the magnetic measurements of the as yet unexplored general topology of the distant high-latitude magnetosphere an important problem is the question of how the auroral electrojet is closed. Different models suggested for the auroral current systems are reviewed. A common feature of all models is that the magnetic disturbances on the ground are due mainly to the ionospheric currents. It is necessary to use a magnetometer on board a polar orbiting satellite. ESRO

N67-34147# Royal Inst. of Tech., Stockholm (Sweden).
COUPLING BETWEEN THE OUTER MAGNETOSPHERE AND THE HIGH-ALTITUDE IONOSPHERE
L. P. Block *In* ESRO Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes Aug. 1966 p 105–124 refs (See N67-34141 20-29)

Two different kinds of phenomena can account for coupling mechanisms between the magnetosphere and the ionosphere, called here particle and wave phenomena, both being guided by the magnetic field lines. Some particle and wave phenomena with characteristic times ranging from seconds to infinity are considered. The topology of the coupling between the magnetosphere and the ionosphere, involving electric fields parallel to the magnetic field are discussed. It is concluded that many unsolved problems may be illuminated by an accentric polar-orbiting satellite carrying magnetometers, plasma probe, particle counters and other measuring instruments. Finally in order to plan electric fields measurements some expected orders of magnitude are listed. ESRO

N67-34151# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
RECENT RESULTS FROM SATELLITE MEASUREMENTS OF LOW-ENERGY PARTICLES PRECIPITATED AT HIGH LATITUDES
J. E. Evans, R. G. Johnson, R. D. Sharp, and J. B. Reagan *In* ESRO Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes Aug. 1966 p 209–234 refs (See N67-34141 20-29)

The low-energy particle data taken over the last few years at high latitudes are presented. The data from two flights taken from low-altitudes in May 1963 and for five days in October and November 1963 are emphasized. The precipitation patterns for protons and electrons are given, and the pattern of proton precipitation is described. ESRO

N67-34152# Southampton Univ. (England).
ENERGETIC PARTICLE OBSERVATIONS FROM IMP SATELLITES
P. Rothwell *In* ESRO Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes Aug. 1966 p 235-247 refs (See N67-34141 20-29)

An analysis of data from the Berkeley energetic particle experiment on IMP-B is reported, in which (1) the position of the boundaries of the Van Allen trapping region and the distant radiation zone were mapped as a function of radial distances from the earth, magnetic latitude and local time; and (2) the sharp sporadic increases in 40 keV electrons beyond the boundary of the distant radiation zone on the darkside of the earth were compared with ground magnetometer data. ESRO

N67-34154# Rice Univ., Houston, Tex. Dept. of Space Science.
PARTICLE MEASUREMENTS OF AN ESRO SATELLITE (NEUTRAL 1) IN A HIGHLY-ECCENTRIC POLAR ORBIT
Brian J. O'Brien *In* ESRO Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes Aug. 1966 p 259-277 refs (See N67-34141 20-29)

The project of launching an ESRO satellite (Neutral 1) into a highly-eccentric polar orbit in order to explore the neutral points which play a pivotal role in determining the magnetospheric configuration is discussed. Scientific aims of such a satellite are listed, and emphasis made on high-altitude measurements of the boundary of the trapping. Associated instrumentation is suggested and it is concluded that the Neutral 1 should be instrumented with magnetometers, plasmas and magnetic particle detectors to an altitude of 26 R_e in high-inclination orbit. Thus, the satellite should probe regions of the unexplored magnetosphere. ESRO

N67-34155*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
POSSIBLE PARTICLE MEASUREMENTS IN THE HIGH LATITUDE MAGNETOSPHERE
R. A. Hoffman *In* ESRO Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes Aug. 1966 p 279-298 refs (See N67-34141 20-29) CSCL 04A

A small standardized spacecraft is suggested for investigating the magnetospheric phenomena with particle detectors in order to measure particles both near the equatorial plane and in the auroral zone. A few high latitude experiments which should be performed are outlined. The choice of the orbit of the ESRO satellite is discussed as well as experimental measurements and the instrumentation requested. ESRO

N67-34158*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ORBITAL FLUX INTEGRATIONS WITHIN THE SUBSYNCHRONOUS REGIONS OF THE GEOMAGNETIC CAVITY, PART I
E. G. Stassinopoulos Mar. 1967 18 p refs
(NASA-TM-X-55875; X-641-67-359) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A computer code to calculate omnidirectional vehicle encountered trapped particle fluxes was developed. Using this code, fast and accurate orbital flux computations can be performed for arbitrary circular or elliptical trajectories within the geomagnetic cavity bounded by L = 6.6 earth radii. The method of calculating the trapped particle intensities, the geomagnetic field models employed in obtaining the magnetic coordinates B and L, and the models of the radiation environments used in the flux calculations are presented. Solar cycle effects on the belts and other time dependent variations in the proton and electron populations are briefly examined. The decay of the artificial Starfish component of the electron environment is considered. Limits and limitations of models, stepsize and duration of calculations, and other methods of computations are also discussed. Author

N67-34357# California Univ., Berkeley. Space Sciences Lab.
A MEASUREMENT OF THE COSMIC MICROWAVE BACKGROUND TEMPERATURE AT 1.5 CM. WAVELENGTH
W. J. Welch, S. Keachie, D. D. Thornton, and G. Wrixon [1967] 13 p refs *Its* Space Sci. Lab. Ser. No. 8, Issue No. 37
(Contracts AF 19(628)-5884; Nonr-222(54))
(AD-653449) CFSTI: HC $3.00/MF $0.65

This report discusses the measurement of the cosmic microwave background temperature at 1.5 cm. wavelength; the result is 2.0 plus or minus 0.8 degrees K. Experimental techniques and the sources of error are mentioned. TAB

N67-34575# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
SOME PROBLEMS PERTAINING TO THE MACROSCOPIC STABILITY OF THE SURFACE OF THE MAGNETOSPHERE
A. Charles Buffalano (Ph.D. Thesis) 1967 103 p refs

In recent years, a great deal of attention has been focused on the physical phenomena associated with the interaction of the solar wind and the geomagnetic field. Satellite observations indicate that fluctuations in the solar wind caused by solar activity induce oscillations of the interaction zone causing magnetic storms and the precipitation of particles into the magnetosphere. The author has investigated the large scale surface dynamics of the dayside of the magnetosphere by a theoretical study of the Chapman-Ferraro, Ideal Magnetohydrodynamic, and Chew Goldberger Low models of the interaction. The work reported is essentially a phenomenological study to determine the importance of some specific mechanisms which lead to surface instabilities. The important part which the convection of disturbances plays in controlling surface instabilities is shown and leads to the conclusion that, for the models considered at least, the possibility of large amplitude surface disturbances on the dayside of the magnetosphere appears remote. Author

N67-34739*# California Univ., Berkeley. Dept. of Physics.
DAYTIME OBSERVATION OF ENERGETIC AURORAL ZONE ELECTRONS
M. Lampton Apr. 1967 20 p refs
(Grant NsG-387)
(NASA-CR-87823) CSCL 04A

Daytime electron precipitation has been observed from on board Nike Apache sounding rockets launched in Canada. Energy spectra and pitch angle distributions are presented. Rapid time variations are seen at energies greater than 60 keV, and travel time arguments indicate that the precipitation cause acts within a few R_e of the earth. Author

N67-34906 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THE LOWER LIMIT OF TRANSVERSE MOMENTUM AND FOUR-MOMENTUM TRANSFER OF RECOIL PROTONS IN HIGH ENERGY INTERACTIONS OF SECONDARY PARTICLES COMING FROM COSMIC RAY JETS [DOLNA GRANICA PEDU POPRZECZNEGO I PRZEKAZU CZTEROPEDU PROTONON ODRZU TU W ODDZIALYWANIACH WYSOKOENERGETYCZNYCH CZASTEK WTORNYCH Z JETOW KOSMICZNYCH]
Jan Babecki 1967 12 p refs
(INR-793/VI/PH)

The purpose of this work was the determination of the transverse momenta and four-momenta of recoil protons in the intersections of high energy secondary cosmic ray particles (a large fraction of which correspond to π-nucleon interactions), as well as a comparison of results with those obtained previously for nucleon-nucleon collisions. The method applied was based on the calculation of transverse momenta and four-momenta for all jet tracks, assuming that a given track belongs to recoil proton, and on further selection of the smallest possible value of p_1 and δ_2. For secondary jets, as previously for primary ones, distributions of the smallest possible p_1-values of recoil protons have been obtained, average p_1-values being considerably larger than those of pions. Accordingly, the obtained values of four-momentum of recoil protons are also large, of the order of several GeV/c. Author

N67-34960 Osservatorio Astronomico di Roma (Italy).
SOLAR PHENOMENA
Massimo Cimino Jun. 1967 19 p *Its* Monthly Bull. 114

Tables and diagrams illustrate solar phenomena collected at the Rome observatory. Daily total areas of sunspot groups are given for June 1967; and heliographic position, classification, and area of sunspot groups are tabulated for numbers 4631 through 4642 for various days between May 17 and June 3. Longitudinal sunspot magnetic fields are illustrated for some of the groups; and the hours of cinematographic patrol are indicated for the entire month of June for K-line and H. M.W.R.

N67-35043*# National Aeronautics and Space Administration, Washington, D. C.
RESONANCE SCATTERING OF SOLAR RADIATION IN PROMINENCES
N. A. Yakovkin and M. Yu. Zel'dina *In its* Probl. of Astrophys. Aug. 1967 p 1–14 refs (See N67-35042 20-30)

It is shown that prominences emit in the line H_α due to the scattering of solar radiation. The proof is based on the solution of an integral equation for the case of fully incoherent scattering. Photospheric radiation in the line H_α enters into the prominence and excites its glow in spite of the great optical thickness of the prominences in this line. The density of diffusion radiation is higher than the average density of the radiation entering into the prominence. The theoretical line profile under great optical thickness ($\tau \geq 10$) has a typical saddle shape. The central intensity and equivalent widths of the calculated line profile agree with the observations. Author

N67-35044*# National Aeronautics and Space Administration, Washington, D. C.
COMPARISON OF FAINT AND BRIGHT PROMINENCES
N. N. Morozhenko *In its* Probl. of Astrophys. Aug. 1967 p 15–27 refs (See N67-35042 20-30)

As a result of analyzing hydrogen and metal lines, the values of the electron temperature, electron concentration, concentration of neutral hydrogen and effective thickness in hydrogenous and metallic filaments of bright prominences are obtained. Owing to lack of data, it is possible in faint prominences to determine only the limits of the change of these values in hydrogenous filaments. The distinction in the spectra of faint and bright prominences may be explained by the difference in optical thickness, which is as high as 2–3 orders in the hydrogen and ionized calcium lines. Author

N67-35045*# National Aeronautics and Space Administration, Washington, D. C.
RESULTS DERIVED FROM SPECTROPHOTOMETRY OF SEVERAL PROMINENCES
M. Yu Zel'dina and A. N. Sergeyeva *In its* Probl. of Astrophys. Aug. 1967 p 29–37 refs (See N67-35042 20-30)

Spectra were obtained for four bright prominences with a dispersion of 0.85 Å/mm. The kinetic temperature, Doppler halfwidths and the population of the excited levels of atoms of hydrogen, helium, and metals are determined. Author

N67-35046*# National Aeronautics and Space Administration, Washington, D. C.
MECHANISM OF HYDROGEN EXCITATION IN PROMINENCE SURGES
M. S. Geychenko *In its* Probl. of Astrophys. Aug. 1967 p 39–42 refs (See N67-35042 20-30)

The steady state equations are solved for the 3rd, 4th, and 6th hydrogen levels of surges. The values of the electronic concentratipn are calculated. The mechanism of excitation of the 3rd, 4th, and 6th hydrogen levels in surges is photospheric radiation and radiative recombination. This is determined by the absolute magnitudes of the terms of these equations. Author

N67-35047*# National Aeronautics and Space Administration, Washington, D. C.
ON THE MECHANISM OF EMISSION BORDER FORMATION IN FILAMENTS
R. I. Kostik and T. V. Orlova *In its* Probl. of Astrophys. Aug. 1967 p 43–47 refs (See N67-35042 20-30)

Additional excitation of the chromosphere by photospheric radiation reflected from a filament is considered as one cause of emission border formation. A formula is obtained for estimating the border brightness. At the same time it explains the principal data (increase of border contrast at the center-limb passage, decrease of border intensity with filament height above the photosphere). The estimated values of the border brightness are in good agreement with the observations. Author

N67-35048*# National Aeronautics and Space Administration, Washington, D. C.
RESEARCH ON CALCIUM LUMINESCENCE IN A GREAT CHROMOSPHERIC FLARE
K. V. Alikayeva *In its* Probl. of Astrophys. Aug. 1967 p 48–58 refs (See N67-35042 20-30)

Consideration is given to the ionized calcium luminescence in the chromospheric flare of July 12, 1961. The central parts of the H and K line profiles are broadened by nonthermal random velocities, and in the wings by non-Maxwellian velocity distribution. The change in electronic density, temperature, and effective length of the calcium filaments with time is determined. Author

N67-35049*# National Aeronautics and Space Administration, Washington, D. C.
SPECTROPHOTOMETRY OF THE SUNSPOT OBSERVED ON JUNE 19, 1959
Ye. N. Zemanek and A. P. Stefanov *In its* Probl. of Astrophys. Aug. 1967 p 59–64 refs (See N67-35042 20-30)

The equivalent widths of 107 Fe I lines were measured in the region 6520–4870 Å. A curve of growth was constructed, and the physical parameters for the sunspot were derived. A graphic method is proposed for determining excitation temperature from the growth curve. The dependence of the equivalent widths of the lines on the strength of the magnetic field, and the spot's position on the solar disk are shown by comparing them for four spots. Author

N67-35050*# National Aeronautics and Space Administration, Washington, D. C.
ON THE H_α LINE EXCITATION MECHANISM IN THE SOLAR CHROMOSPHERE
R. I. Kostik *In its* Probl. of Astrophys. Aug. 1967 p 65–70 refs (See N67-35042 20-30)

The profiles of chromospheric H_α are estimated for certain heights above the photosphere. Photospheric radiation is regarded as a source of excitation. It is shown that both external and internal sources are almost equally responsible for the luminescence of the H_α line. The relative role of internal sources of excitation increases with the height above the photospheric level. Author

N67-35051*# National Aeronautics and Space Administration, Washington, D. C.
INFLUENCE OF DISSIPATION ON PLASMA EQUILIBRIUM IN A MAGNETIC FIELD
L. M. Shul'man *In its* Probl. of Astrophys. Aug. 1967 p 71–77 refs (See N67-35042 20-30)

Plasma equilibrium conditions are formulated, taking into consideration dissipative processes. The electron thermo- and electroconductivity are specially considered. There are some cases when the investigation of dissipative plasma equilibrium can be reduced to the solution of some plane and one-dimensional problems. One-dimensional equilibrium configurations with a constant magnetic field gradient and constant density of matter are discussed. The effect of volume sources and energy loss is examined in the case when they predominate in the establishment of thermal equilibrium. Author

N67-35052*# National Aeronautics and Space Administration, Washington, D. C.
ON THE CHOICE OF THE PRE-FLARE PLASMA STATE MODEL
L. M. Shul'man *In its* Probl. of Astrophys. Aug. 1967 p 78–82 refs (See N67-35042 20-30)

The formulation of a theoretical flare model is discussed based on the premise that the pre-flare state has to be an equilibrium state up to very slow processes. It is shown that acoustic heating and radiation rapidly set up thermal equilibrium in the chromospherical plasma, and that the models formerly proposed are incorrect unless they satisfy the thermal equilibrium conditions. Author

N67-35060 Milan Univ. (Italy). Inst. of Physical Sciences.
SECONDARY COSMIC RAY ELECTRONS PRODUCED IN INTERSTELLAR MEDIUM. I: GALACTIC SECONDARY ELECTRON SOURCES
G. C. Perola, L. Scarsi, and G. Sironi 1967 25 p refs

Calculations of secondary electrons from meson decay, based on experimental data on meson production, are discussed. Two possibilities for the total energy spectrum are considered: the spectrum in the galaxy coincides with that observed near earth at solar minimum, and the spectrum observed near earth at solar minimum is representative of the galactic spectrum only for energies greater than 10 GeV/nucleon. The pion production in proton–proton collisions is investigated, and the energy spectra of the negative and positive pions are obtained. The electron source energy spectrum is deduced from the pion source. The knock-on electron from the collisions of cosmic ray nuclei with the interstellar matter are also considered. Data are graphed and tabulated. N.E.N.

N67-35165# Max-Planck-Institut fur Physik und Astrophysik, Munich (West Germany).
COMETS IN THE SOLAR WIND [KOMETEN IM SONNENWIND]
B. Brosowski and H. U. Schmidt May 1967 11 p refs
(MPI-PAE/ASTRO-1/67) CFSTI: HC $3.00/MF $0.65

The flow conditions in case of pure photoionization along the axis sun–comet had been determined previously for a number of solar and cometary parameters, and the position of the contact area and the shock front in dependence from these parameters as well as a numerical method for the model calculations had been discussed. Presented in this paper are model calculations which take into account the effects of the change in charge and ionization through electron impact. Transl. by K.W.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N67-34086*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
SCIENTIFIC MISSION SUPPORT FOR EXTENDED LUNAR EXPLORATION. VOLUME 2: TASK SUMMARY Final Report
Dec. 1966 115 p *refs*
(Contract NAS8-20258)
(NASA-CR-87400; SID-66-957-2) CSCL 22A

Experimental systems, technology, and operational requirements for establishing typical lunar scientific programs are evaluated. Experiment sequences are formulated to identify logical exploration phases and the interdisciplinary relationships of experiments, based on experiment support requirements. Predicted lunar astronaut working capability and long and short range mobility were investigated. Systems and subsystems requirements were studied for transport and emplacement of large scientific facilities, and scientific personnel requirements were assessed. Results of this study are to provide information to be used for the Mission Modes and Systems Analysis for Lunar Exploration (Mimosa), and for other lunar exploration studies. E.C.

N67-34087*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
SCIENTIFIC MISSION SUPPORT FOR EXTENDED LUNAR EXPLORATION. VOLUME 1: CONDENSED SUMMARY Final Report
Dec. 1966 38 p refs
(Contract NAS8-20258)
(NASA-CR-87399; SID-66-957-1) CFSTI: HC $3.00/MF $0.65 CSCL 22A

An overview is presented of the objectives, guidelines, and basic data derived from an extensive study on scientific support requirements for extended lunar exploration missions. Relationships of this study to other space research efforts, particularly "Mission Modes and Systems Analysis for Lunar Exploration" (Mimosa), are

discussed. Tabular data arranged by scientific discipline reflect typical fundamental investigations and experiments. An experiment data management system is outlined, providing for organization, storage and retrieval, updating, and handling of lunar experiment and associated equipment and support data. Mission support requirements are defined in terms of developing scientific equipment, astronaut training programs, and lunar systems planning. E.C.

N67-34106*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
SCIENTIFIC MISSION SUPPORT FOR EXTENDED LUNAR EXPLORATION. VOLUME 3: DETAILED TECHNICAL REPORT Final Report
Dec. 1966 425 p refs
(Contract NAS8-20258)
(NASA-CR-87401; SID-66-957-3) CSCL 22A

Details are presented on the investigations to be performed during lunar exploration and on the experimental systems and operational requirements for typical lunar surface and lunar-orbital programs. The individual experiments are described in the areas of lunar atmospheres, geodesy, geology, geochemistry, geophysics, particles and fields, biology, and astronomy. The requirements are discussed with respect to mission support activities, experiment equipment, mass and energy needs, and astronaut capability and hours necessary for the experiments. The experiments are organized into the discipline sequences, mission support sequences, exploration phase sequences, and composite sequences. The earth-based support requirements, and the data management system are also covered. N.E.N.

N67-34107* North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
SCIENTIFIC MISSION SUPPORT FOR EXTENDED LUNAR EXPLORATION. VOLUME 6, APPENDIX C: COMPUTER PROGRAM Final Report
Dec. 1966 293 p refs
(Contract NAS8-20258)
(NASA-CR-87402; SID-66-957-6) CSCL 22A

The data handling procedures which were used to compile information on experiments and support equipment are presented. The subject data were encoded for keypunching on standard IBM cards. The essential features of the data compilation procedures are described and provide a guide for the preparation of input data cards, allowing the user to decode and interpret the quantitative information, and add or revise experiments as necessary. The digital computer allows the accumulation of data, permits changes to the raw data, allows updating of summary information, and facilitates rapid retrieval of selected information. The codes and definitions necessary to interpret both input and output data and descriptions of the computer programs are presented. The numerical codes were selected to provide the maximum utilization of system operations and support system requirements for mission planning consistent with the available data sources. Provisions were made to accommodate changes by replacement of input data cards, or tape stored records. The computer program includes routines for maintenance of the master data compilation. Author

N67-34121* North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
SCIENTIFIC MISSION SUPPORT FOR EXTENDED LUNAR EXPLORATION. VOLUME 4, APPENDIX A: EXPERIMENT SEQUENCES-COMPUTER PRINTOUTS Final Report
Dec. 1966 182 p
(Contract NAS8-20258)
(NASA-CR-87403; SID-66-957-4) CFSTI: HC $3.00 CSCL 22A

The printouts presented are; the Discipline Sequences which order the experiments of each discipline area according to the desires of the scientific community to ensure a logical progression of scientific knowledge and accomplishment; the Mission Support Sequences which order the experiments within each discipline and across disciplines by ascending order of magnitude of the mission-support parameters of mass, energy, and man-hours; the Exploration Phase Sequences which order the experiments by discipline into logical operational areas or phases of lunar exploration; and the Composite Sequences which order the experiments of each exploration phase into interdisciplinary groupings according to key functional items or operations. The sequence printouts show the information on the summary cards. This card is machined-produced by extracting information from the other data cards for presentation in summary form. Author

N67-34135 General Electric Co., Philadelphia, Pa. Missile and Space Div.
TABLES OF THERMODYNAMIC PROPERTIES OF MARS ATMOSPHERES FOR CALCULATING EQUILIBRIUM FLOW FIELDS, PART I
C. L. Kyriss and A. Miles 12 Dec. 1966 35 p refs
(ATDM-66-1)

Thermodynamic data for three Martian model atmospheres have been processed for use in the GE-RSD flow field system for real gases in chemical equilibrium. The results of this work are reported in three parts. Part I treats the model composition: 4.9% CO_2-95.1% N_2 by volume, over the temperature range 90°R to 27,000°R and $\log_{10} \rho/\rho_0$ range −7.0 to 1.0. Part II treats the model composition: 9% CO_2-90% N_2-1% A by volume, over the temperature range 90°R to 27,000°R and $\log_{10} \rho/\rho_0$ range −7.0 to 1.8. And Part III treats the model composition: 48.8% CO_2-51.2% N_2 by volume, over the temperature range 90°R to 17,100°K and $\log_{10} \rho/\rho_0$ range −7.0 to 1.0. Author

N67-34153# Imperial Coll. of Science and Technology, London (England).
SUGGESTIONS FOR MAGNETOSPHERIC EXPERIMENTS
J. J. Quenby *In* ESRO Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes Aug. 1966 p 251-257 refs
(See N67-34141 20-29)

Some possible projects for magnetospheric experiments are discussed, including: high inclination eccentric orbit satellite, one/two satellites launched into the magnetospheric tail, and also a satellite investigating the interaction of VLF and hydromagnetic waves with trapped particles in the region L=1-10. ESRO

N67-34216# TUAB Teleutredningar A.B., Solna (Sweden). Space Technology Group.
SOUND RANGING COMPUTATIONS FOR SOUNDING ROCKET RECOVERY
Johan Martin-Loef Apr. 1967 21 p refs Sponsored by NASA and Swed. Space Res. Comm.
(Rept.-67-K2) CFSTI: HC $3.00/MF $0.65

An acoustic method to locate an object that enters into the earth's atmosphere at supersonic speed is presented. The direction of the object is computed from shock wave arrival times observed with the aid of infra-sonic microphones. A numerical method for the computations is described. This method gives a least squares estimate of the direction of the normal to an idealized plane shock wave. It has been successfully used in a computer program to reduce data collected during the sounding rocket experiments in Northern Sweden in 1964. Author (ESRO)

N67-34489*# Scientific Translation Service, La Canada, Calif.
SURFACE LAYER OF THE MOON [POVERKHNOSTNYY SLOY LUNY]

A. A. Gurshteyn Washington, NASA, Aug. 1967 24 p Transl. into ENGLISH from Priroda (Moscow), no. 6, Jun. 1967 p 1-15
(Contract NASw-1496)
(NASA-TT-F-11210) CSCL 03B

Information on the moon derived by astronomers is summarized. Data on the spacecraft sent to the moon in the last eight years are given, starting with Luna-1 in 1959 and including the American spacecraft in the Lunar Orbiter, Ranger, and Surveyor series. Author

N67-34542*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
PROJECT TECH TOP STUDY OF LUNAR, PLANETARY AND SOLAR TOPOGRAPHY Final Report
D. A. Richards, J. D. Gallatin, and R. O. Breault Jul. 1967 350 p refs
(Contract NAS12-19)
(NASA-CR-85008; VC-2104-D-2) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A program to assess the state of the art and to make recommendations for future research in topographic information collection systems for planetary and solar investigation is discussed. Continued analysis of planetary topography to include the initiation of a detailed system analysis, a review and analysis of image restoration processes and their application to space imagery, and some mapping considerations for a stereo imagery system are presented. Three major aspects of solar topography, theoretical, engineering and experimental, were investigated. The theoretical aspects concerned the concepts, phenomena and problems of major importance to the study of the sun. The engineering aspects concerned solar probe feasibility and survivability, the use of cooperating vehicles, and earth-based solar instrumentation. Two experimental possibilities were examined involving the use of an active backscatter probe of the sun and the use of Fourier transform spectroscopy in space. Specific recommendations for future research and experimentation and a bibliography are included. Author

N67-34551*# Harvard Coll. Observatory, Cambridge, Mass. Meteor Dept.
A THEORETICAL STUDY OF METEORIC TRAJECTORIES AND PROCESSES, INCLUDING EXAMINATION OF THE INCIDENCE AND CHARACTERISTICS OF PHOTOGRAPHIC METEORS BY REDUCTION OF ABOUT 600 DATA POINTS
Annette Posen and Richard E. McCrosky Washington, NASA Aug. 1967 52 p refs
(Grant NsG-460)
(NASA-CR-862) CFSTI: $3.00 CSCL 03A

A newly developed, efficient, automatic-reduction procedure for photographic meteor data is described. The time required to process a pair of films is reduced from 24 to 3 man-hours. This is due mainly to an electronic computer program that automatically identifies the stars on a photographic film. It is necessary to know the approximate (±5°) hour angle and declination of the center of the star field of the film (the direction of the camera's optical axis) and the focal length of the camera. This automatic star-identification technique can be widely applied to astronomical photographic data. New, precisely computed orbits for 357 meteors are presented. Author

N67-34573# California Univ., Berkeley. Radio Astronomy Lab.
STUDIES OF GALACTIC CLUSTERS AND GALACTIC PARAMETERS Final Report
Harold Weaver Nov. 1964 137 p refs
(Contract AF 19(604)-6170)
(AFCRL-64-940; AD-654002) CFSTI: HC $3.00/MF $0.65

The principal goals of the research were: To learn more about the larger environs of the sun primarily by investigation of the OB stars, classical cepheids, and galactic clusters. To investigate the field of motion of the galaxy on the basis of the motions of OB stars and cepheids. To derive a model of the galaxy, particularly investigating the question of galactic expansion, and so far as possible combining results from OB stars and cepheids with data from neutral hydrogen. As steps towards these goals, we here present a catalog of newly discovered star clusters, photoelectric observations of 64 northern cepheid variables, a study of several photometric systems on which cepheid variables have been observed, an investigation of the distances of galactic clusters, an investigation of the absolute magnitudes of early-type stars, a preliminary investigation of non-circular motions of the OB stars, an investigation of the similarity of distances of early-type stars and neutral hydrogen gas, investigation of the galactic rotation parameters derived from cepheid variables. Author (TAB)

N67-34594* North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
SCIENTIFIC MISSION SUPPORT FOR EXTENDED LUNAR EXPLORATION, VOLUME 5: APPENDIX B: MASTER DATA REPORT—COMPUTER PRINTOUTS Final Report
Dec. 1966 913 p
(Contract NAS8-20258)
(NASA-CR-87405; SID-66-957-5) CSCL 22D

A detailed description of the experiments compiled and formulated for the NASA study, Scientific Mission Support for Extended Lunar Exploration (NAS8-20258), is provided. To accomplish the study, it was necessary to assimilate, catalog, and retrieve a large variety of data on the experiments. It was impossible to accomplish this task within the desired schedule by using manual methods. The application of a digital computer satisfied the requirements. The experiments are described in terms of operational support requirements which are reproduced from computer printouts. The printouts which are presented, display the encoded information which was initially keypunched on IBM data cards to facilitate abstracting, sorting, retrieval, and display, in a variety of output formats. Author

N67-34596# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
DUST PARTICLE TERMINAL VELOCITIES IN VENUS ATMOSPHERE FROM 0 TO 100 KILOMETERS
Albert D. Anderson May 1967 18 p refs
(LMSC-6-77-67-18)

In order to better understand the possible generation, persistence, and particle size range of dust in the Venus atmosphere, terminal velocities are calculated for spherical particles with diameters from one to 10,000 microns for three model atmospheres over the altitude range 0 to 100 km. The model atmospheres are based on minimum (30 atm; 620°K), most probable (50 atm; 688°K), and maximum (300 atm; 720°K) surface pressures and temperatures. Assuming a solid surface and the availability of dust on the ground, the following conclusions are reached: (1) The falling rates for the smaller dust particles (less than 50 microns) show the least sensitivity to the model used at the lower altitudes (less than 40 km) and the greatest sensitivity at the higher altitudes (90–100 km); (2) For all sizes considered, the vertical winds required to maintain particles aloft in the lower Venus atmosphere are less than one-half those needed on earth. Therefore, for the same degree of convective activity, one should expect more dust, consisting of larger particles ranging in size up to several hundreds of microns in diameter; (3) If, as is probable, Venus has much more convective activity than earth, then it is likely that a great deal more dust exists there, whose maximum size is on the order of one thousand microns in diameter. These last two conclusions lend support to Opik's Asolosphere Model. Author

N67-34604*# IIT Research Inst., Chicago, Ill.
THE ACCESSIBLE REGIONS PRESENTATION OF GRAVITY-ASSISTED TRAJECTORIES USING JUPITER
D. A. Klopp and J. C. Niehoff Jun. 1967 45 p refs
(Contract NASr-65(06))
(NASA-CR-87495; T-18) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The regions of the solar system accessible to a spacecraft launched from Earth onto a trajectory incorporating a Jupiter gravity-assist maneuver are delineated. These regions of accessibility are presented on a heliocentric latitude-radius plane, normal to the ecliptic plane, with launch energy and time of flight as parameters. Out-of-ecliptic as well as planetary mission capability is emphasized. The results show that a spacecraft, launched from Earth with an energy just sufficient to reach Jupiter, can explore the solar system beyond Pluto if the Jupiter gravity-assist technique is used. Comparisons are made with the solar system exploration capabilities of spacecraft using direct ballistic flight trajectories. A specific comparison of ballistic, Jupiter gravity-assisted, and nuclear low thrust flight modes is given. The method of analysis and a computer program are discussed. Author

N67-34627*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA SYMPOSIUM ON TRAJECTORY ESTIMATION
9 Dec. 1966 35 p Symp. held 18–19 Oct. 1966
(NASA-TM-X-60228) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The proceedings of a symposium on the present state of the theory and practice of trajectory estimation are summarized. The presentations covered factors describing and affecting the accuracy of distant space probe navigation using earth based tracking data, sequential processing of tracking data, a stochastic modelling problem in orbit determination, sequential estimation of measurement error variances, scientific satellite orbit determinations, orbit determination for lunar orbiter, operational problems in Gemini trajectory determination, pragmatic problems of trajectory estimation, Kalman filtering applied to real data, planning Apollo navigation procedures, identifying random forces on interplanetary spacecraft, comet orbit determination, and state estimation with acceptable tolerance constraints. Abstracts of the presentations and the transcript of a panel discussion are included. R.N.A.

N67-34631*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
PRELIMINARY INVESTIGATION OF A LUNAR "ROLLING STONE"
J. M. Eggleston, A. W. Patteson, J. E. Throop, W. H. Arant, and D. L. Spooner Mar. 1967 14 p refs
(NASA-TM-X-58007) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Based on Orbiter II photographic analyses, a preliminary investigation was made of boulders which appeared to have rolled down the interior wall of the lunar crater, Sabine D, in the southwestern area of Mare Tranquillitatis. Stereoscopic measurements were taken of the path to determine the crater's depth; a microdensitometer was used to confirm measurements of the dimensions of the boulder and the track down the crater wall. Initial data indicate: (1) Large, cohesive, and near-spherical boulders exist on the lunar surface. (2) At least a few lunar boulders have moved or have been moved recently enough so that their tracks have not been obliterated by lunar erosion processes. (3) One such boulder, whose reflectance properties were analyzed by microdensitometer measurements, appears to reflect as a Lambert surface. (4) The wall of Sabine D, with a slope of about 30°, appears to be covered with a compressible material which failed under the pressure of the boulder as it moved down the slope. M.G.J.

N67-34670*# Texas Univ., Austin.
MOTION OF A SPACECRAFT NEAR A TRIANGULAR LIBRATION POINT OF THE EARTH-MOON SYSTEM
Bob Ewald Schutz (M.S. Thesis) Jan. 1966 194 p refs
(Contract NAS9-2619)
(NASA-CR-65677; TCR-6) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The motion of a spacecraft near the triangular earth–moon libration points is studied to determine the nature of the long term motion. Two different mathematical models are used. In one model, it is assumed that the earth and the moon move in circular orbits around their barycenter, the barycenter moves in a circular orbit around the sun, and the earth-moon plane regresses with a constant rate of one revolution in 18.6 years. Two initial orientations of the earth-moon-sun system are used. In the other mathematical model, ephemeris information is used to represent the physical world to a much greater extent than the model with circular orbits. The sun and all planets except Uranus, Neptune, and Pluto, are included in this "real world" model. Two initial dates are used, viz., January 10, 1967, 12^{h}GMT, and November 2, 1967, 5.^{h}64 GMT. The equations of motion for each of the two models are numerically integrated and the results of the models for approximately the same initial orientation are compared. The results of the study lead to the conclusions that (1) the modified four-body model with circular orbits and nodal regression does not simulate very well the "real world" model which uses ephemeris information (2) the initial date and the initial velocity specification have an important effect on the subsequent motion; and (3) long-term stability of greater than five years is found to exist in the "real world" model. Author

N67-34685*# TRW Systems, Redondo Beach, Calif.
MISSION ORIENTED STUDY OF ADVANCED NUCLEAR SYSTEM PARAMETERS, PHASE IV, VOLUME III Final Report, May 1965–Dec. 1966
A. R. Chovit and L. D. Simmons Dec. 1966 35 p ref
(Contract NAS8-5371)
(NASA-CR-87487; TRW-01977-6007-R000, Vol. 3) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A discussion is presented of the areas of research and technology in which further efforts would be desirable based on the results of a study of manned Mars stopover missions in the decade following 1980. This study included comparison of opposition class, conjunction class, and Venus swingby missions; analyses of launch window provisions and mission aborts; and an investigation of launch azimuth constraints. The areas of research and technology that are discussed include the determination and estimates of system and performance assumptions, supplementary research of operational criteria, and the implications the study results have on future mission analyses. Author

N67-34715*# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
THE SEPARATE COMPUTATION OF ARCS FOR OPTIMAL FLIGHT PATHS WITH STATE VARIABLE INEQUALITY CONSTRAINTS
Jason L. Speyer, Raman K. Mehra, and Arthur E. Bryson, Jr. May 1967 37 p refs
(Grant NGR-22-007-068; Contract Nonr-1866(16))
(NASA-CR-87510; TR-526) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Separate computation of arcs is possible for a large class of optimization problems with state variable inequality constraints. Surprisingly, this class includes all physical problems which have been solved analytically or numerically to date. Typically these problems have only one constrained arc. Even in more complex problems, separation of arcs can be used to search for additional constrained arcs. As an important example, a maximum range

trajectory for a glider entering the Earth's atmosphere at a supercircular velocity is determined, subject to a maximum altitude constraint after initial pull-up. It is shown that the optimal path can be divided into three arcs, which may be determined separately with no approximations. The three arcs are (1) the initial arc, beginning at specified initial condition and ending at the entry point onto the altitude constraint; (2) the arc lying on the altitude constraint; and (3) the terminal arc, beginning at the exit point of the altitude constraint and ending at some specified terminal altitude. Author

N67-34719# General Electric Co., Philadelphia, Pa. Missile and Space Div.
SATELLITE DESCENT INFLUENCE COEFFICIENTS
S. Matlin. 9 Sep. 1966 76 p refs
(Doc.-66SD311)

A satellite in a circular orbit initiates an impulsive retardation velocity to impact the earth. This report displays plots of the resulting range to re-entry and the effects of errors in the retardation velocity propagated to the re-entry plane. Applications include error analyses of data return capsules and rapid determination of nominal retardation velocities required to achieve specified range to re-entry for preliminary design purposes. Author

N67-34761*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-45, VOLUME IV FOR THE PERIOD APRIL 1, 1967 TO MAY 31, 1967. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
30 Jun. 1967 363 p refs
(Contract NAS7-100)
(NASA-CR-87450; JPL-SPS-37-45, Vol. IV) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Articles on JPL space exploration programs and related supporting research and advanced development projects are presented. For individual titles, see N67-34761 through N67-34781.

N67-34762*# Jet Propulsion Lab., Calif. Inst of Tech., Pasadena.
SYSTEMS ANALYSIS
In its Space Programs Sum. No. 37-45, Vol. IV 30 Jun. 1967 p 1-16 refs (See N67-34761 20-30)

Two optimum strategies are briefly described for selecting interplanetary midcourse correction aiming points when such points are restricted by a planetary quarantine constraint. The first maximizes the probability of being within the final success zone after the midcourse correction, while minimizing need of additional corrections. The second considers choosing the first midcourse correction aiming point to minimize the expected square of the miss rather than to maximize the success probability. Preliminary results of a trajectory analysis of a low-thrust solar electric flyby mission to Jupiter are presented. Several examples are given to show the application of the discrete probability theory to obtain the mean, variance, and higher moments of distribution. A logical and simple way to extend the definition of the Riemann-Lebesgue integral to include stochastic integrals is formulated. A method of implementing optimal data compression by using polynomials is discussed. It is shown that the effects of small malorientations of the moon's principal axes are reflected in the second-degree gravity harmonics. M.G.J.

N67-34763*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMPUTATION AND ANALYSIS
In its Space Programs Sum. No. 37-45, Vol. IV 30 Jun. 1967 p 17-21 refs (See N67-34761 20-30)

The mass values for ephemeris development are listed, and the independent mass determinations used in constructing the recommended masses are tabulated. The weighted mean values of these data are given, along with tabulations on the earth-moon mass ratio. Also reported are efforts to clarify some of the questions associated with the construction of orbit correction problems. Attention is focused on the practical effects of misinterpretation of the usual formulation of the differential correction relations in rectangular coordinates for a Keplerian reference orbit used as a nominal in computing special perturbations. M.G.J.

N67-34775*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR AND PLANETARY SCIENCES
In its Space Programs Sum. No. 37-45, Vol. IV 30 Jun. 1967 p 235-243 refs (See N67-34761 20-30)

To provide an experimental basis for the geologic interpretation of spectral reflectance measurements of planetary surfaces, laboratory studies were made of particulate rocks. Changes in the wavelength distribution of reflected light were measured as functions of rock composition and mineralogy, particle size, particle shape, particle packing, and angle of illumination. Experimental results indicate that powdered silicate rocks can be classified as rock glasses, crystalline acidic rocks, or crystalline basic-ultrabasic rocks, on the basis of spectral reflectance in the 0.4 to 2.0 μ wavelength region. This led to the conclusion that a combination of several spectral reflectance properties is capable of giving some gross composition information on silicate rock powders. Summary data are provided on determinations of cloud-top pressure and hydrogen abundance in the Jupiter atmosphere. Also considered are four methods of analyzing the visible and near-infrared spectrum of solar energy returned from the lunar surface: photometry, polarimetry, luminescence, and spectrophotometry. Pictorial data are included to show the linear Martian features obtained from Mariner IV photographs. M.G.J.

N67-34781*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FUTURE PROJECTS
In its Space Programs Sum. No. 37-45, Vol. IV 30 Jun. 1967 p 353-363 refs (See N67-34761 20-30)

The many unanswered questions about cometary phenomena are assessed in relation to the importance of a comet-intercept space probe mission for cosmogonical research. To derive the maximum scientific value from such a mission, several constraints are defined. These pertain to launch vehicle capability, intercept miss distance, the desirability of intercept close to perihelion, visibility from earth during intercept, closing velocity, trajectory constraints for approach, fly-through, and recession from the comet, and spacecraft hazard. It is deemed appropriate that the scientific objectives for an early comet mission should be to determine the comet's physical state, structure, composition, and the manner in which it reacts to its environment by investigating the comet at close proximity. To accomplish these objectives, it is suggested that a scientific payload should include the following experiments: photo-imaging, mass spectrometer, dust (solid particle) detector, magnetic field detector, plasma spectrometer, Fourier spectrometer, and cometary mass determination. M.G.J.

N67-34793*# TRW Systems Redondo Beach, Calif.
MISSION ORIENTED STUDY OF ADVANCED NUCLEAR SYSTEM PARAMETERS, PHASE IV, VOLUME I Final Report, May 1965-Dec. 1966
A. R. Chovit and L. D. Simmons Dec. 1966 63 p refs
(Contract NAS8-5371)
(NASA-CR-87489; TRW-01977-6005-R000, Vol. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A summary of the study approach and basic guidelines and assumptions which were used in a series of analyses of manned Mars stopover missions is given. Analyses were performed for five separate study tasks, viz. (1) analyses and comparisons of swingby, opposition, and conjunction class missions, (2) a detailed parametric analysis of the conjunction class mission, (3) an

investigation of the effects of providing launch windows at Earth and Mars for various missions, (4) an evaluation of the vehicle's abort capabilities for various missions, and (5) an analysis to determine the effects of Earth launch azimuth constraints for various missions and launch opportunities. A summary is presented of the results obtained for each of these study tasks with an evaluation of and recommendations based on the results. Author

N67-34835*# IIT Research Inst., Chicago, Ill. Astro Sciences Center.
[STUDIES AND ANALYSES OF SPACE SCIENCE PROBLEM RELATED TO THE PLANNING AND DIRECTING OF NASA LUNAR AND PLANETARY PROGRAMS] Annual Summary Report
Jun. 1967 88 p refs
(Contract NASr-65(06))
(NASA-CR-87506; A-4; ASR-4) CSCL 22A

As a part of a continuing program of research, study, and analysis for NASA lunar and planetary programs, this report presents: (1) summaries of reports on a preliminary payload analysis of automated Mars sample return missions, missions to the outer planets, the origin and evolution of the solar system, Jupiter as an object of biological interest, suggested measurement/instrument requirements for Lunar Orbiter Block III, scientific objectives for total planetary exploration, thermophysical aspects and feasibility of Jupiter atmospheric entry, the accessible regions presentation of gravity assisted trajectories using Jupiter, and the problem of comet orbit determination for spacecraft intercept missions; (2) technical memoranda on analytical techniques for investigating distributional features of the asteroids, a geological analysis for lunar exploration, and low thrust and ballistic payload comparison for Jupiter orbiter missions; and (3) technical notes on Prospectus 67 and operational computer codes. Also included are a list of papers presented and published and a bibliography of reports, technical memoranda, and major computer codes. R.N.A.

N67-34871# Royal Observatory, Edinburgh (Scotland).
REPORT OF THE ASTRONOMER ROYAL FOR SCOTLAND FOR THE YEAR ENDING 31st MARCH 1967
H. A. Bruck 31 Mar. 1967 20 p refs
CFSTI: HC $3.00/MF $0.65

A breakdown of the time allotted for spectroscopic work on the 36-inch telescope, for photographic work on the 16/24-inch Schmidt telescope, and for photoelectric photometric work on the twin 16-inch telescope, is given. Progress on various projects: (1) spectrophotometry of F and G stars, (2) chemical composition of peculiar A stars, (3) dust embedded stars and globules, (4) galactic structure, (5) rotating stars and pre-stars (6) interstellar obscurations, polarizations, bands, and gas dynamics, and (7) photometry of the night sky and of the zodiacal light is reported. Digital and analog computer systems were used for controlling the telescopes. Other developments in studies concerning observations of artificial orbiting satellites, and seismological activities, are also reported. L.S.

N67-34884*# National Aeronautics and Space Administration, Electronics Research Center, Cambridge, Mass.
FLYBY MEASUREMENTS OF THE PROFILES OF WATER VAPOR, PARTICULATE MATTER, AND CARBON DIOXIDE IN THE MARTIAN ATMOSPHERE
Alfred E. Barrington, Anthony J. Caruso, and Gene G. Mannella
Washington, NASA, Aug. 1967 16 p refs
(NASA-TN-D-4115) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A study of infrared absorption measurements in the Martian atmosphere for the determination of the profiles of water vapor and carbon dioxide is presented in quantitative detail. Using the best available data on the Martian atmosphere, it is shown that with state-of-the-art instrumentation the following can be measured: an upper limit of water vapor of 10^{-3} g/cm^2-column (at 6.3 μ), scattering by particulate matter (at 3.5 μ), and the carbon dioxide profile above an altitude of 50 km (at 4.3 μ). The choice of wavelengths and of experimental instrumentation is based on a realistic appreciation of Martian atmospheric characteristics and experience gained during the Mariner II Venus mission. Author

N67-34895* Houston Univ., Tex. Cullen Coll. of Engineering.
ULTRASONIC MODELING OF LUNAR APPROACH OF THE LUNAR EXCURSION MODULE
H. S. Hayre, F. Boyd, and A. Tong 17 Mar. 1967 21 p refs
(Contract NAS9-6760)
(NASA-CR-65670; TR-67-6) CSCL 22C

The ultrasonic modeling system for the Lunar Excursion Module (LEM) system and the lunar surface for three possible landing areas, P-6, P-8, and P-11, is described. The modeling scheme is based on complex nonlinear ultrasonic scaling of radar system parameters. Distances, antenna velocities, and frequency scale factors were selected independently in accordance with size of the ultrasonic simulation facility. Other parameters such as Doppler frequency, wavelength, time delay, etc., are then specified in terms of these previously specified parameters. L.S.

N67-34947*# Consiglio Nazionale Delle Ricerche, Frascati (Italy). Centro Studi di Astrofisica.
GRAVITATIONAL COLLAPSE OF LARGE MASSES AND RELATED PROBLEMS [SUL COLLASSO GRAVITAZIONALE DI GRANDI MASSE E PROBLEMI COLLEGATI]
Alvio Renzini 1967 11 p refs In ITALIAN; ENGLISH summary
Presented at the 10th Meeting of the Ital. Astron. Soc., Catania, Sicily, 27–29 Jun. 1966
CFSTI: HC $3.00/MF $0.65

Equations describing the gravitational collapse of a spherically symmetric body with a radial energy flow are given in a form suitable for numerical integration. The goal is to obtain the diagram of the total energy emitted during the collapse versus the original mass of the object. Numerical computations are in travel. Author

N67-35042*# National Aeronautics and Space Administration, Washington, D. C.
PROBLEMS OF ASTROPHYSICS
Ye. P. Fedorov, ed. Aug. 1967 172 p refs Transl. into ENGLISH of the book "Voprosy Astrofiziki" Kiev, Izd. Naukova Dumka, 1966 p 1–205
(NASA-TT-F-455) CFSTI: HC $3.00/MF $0.65 CSCL 03B

CONTENTS:

1. RESONANCE SCATTERING OF SOLAR RADIATION IN PROMINENCES N. A. Yakovkin and M. Yu. Zel'dina p 1–14 refs (See N67-35043 20-29)

2. COMPARISON OF FAINT AND BRIGHT PROMINENCES N. N. Morozhenko p 15–27 refs (See N67-35044 20-29)

3. RESULTS DERIVED FROM SPECTROPHOTOMETRY OF SEVERAL PROMINENCES M. Yu. Zel'dina and A. N. Sergayeva p 29–37 refs (See N67-35045 20-29)

4. MECHANISM OF HYDROGEN EXCITATION IN PROMINENCE SURGES M. S. Geychenko p 39–42 refs (See N67-35046 20-29)

5. ON THE MECHANISM OF EMISSION BORDER FORMATION IN FILAMENTS R. I. Kostik and T. V. Orlova p 43–47 refs (See N67-35047 20-29)

6. RESEARCH ON CALCIUM LUMINESCENCE IN A GREAT CHROMOSPHERIC FLARE K. V. Alikayeva p 48–58 refs (See N67-35048 20-29)

7. SPECTROPHOTOMETRY OF THE SUNSPOT OBSERVED ON JUNE 19, 1959 Ye. N. Zamanek and A. P. Stefanov p 59–64 refs (See N67-35049 20-29)

8. ON THE H_α LINE EXCITATION MECHANISM IN THE SOLAR CHROMOSPHERE R. I. Kostik p 65–70 refs (See N67-35050 20-29)

9. INFLUENCE OF DISSIPATION ON PLASMA EQUILIBRIUM IN A MAGNETIC FIELD L. M. Shul'man p 71–77 refs (See N67-35051 20-29)

10. ON THE CHOICE OF THE PRE-FLARE PLASMA STATE MODEL L. M. Shul'man p 78–82 refs (See N67-35052 20-29)

11. CONVECTIVE STAR MODEL WITH NON-RIGID ROTATION V. V. Porfir'yev p 83–96 refs (See N67-35053 20-29)

12. CATALOG OF PHOTOGRAPHIC MAGNITUDES OF COMPARISON STARS IN GLOBULAR CLUSTER M92 L. I. Paneva and E. S. Kheylo p 97–102 refs (See N67-35054 20-30)

13. VARIABLE STARS IN GLOBULAR CLUSTER M92 E. S. Kheylo p 103–112 refs (See N67-35055 20-30)

14. CATALOG OF PHOTOVISUAL MAGNITUDES OF STARS IN THE REGION WITH CENTER $\alpha = 19^h$, $\delta = +11°$ V. I. Voroshilov p 113–127 refs (See N67-35056 20-30)

15. SPATIAL DISTRIBUTION OF STARS IN THE REGION WITH CENTER ($\alpha = 18^h50^m$, $\delta = +5°$) V. I. Voroshilov p 128–137 refs (See N67-35057 20-30)

16. THE MILKY WAY IN THE CONSTELLATION AQUILA G. L. Fedorchenko p 138–159 refs (See N67-35058 20-30)

17. EFFECT OF THE EARTH'S ATMOSPHERIC TURBULENCE ON THE LIGHT COLLECTION OF TELESCOPES I. G. Kolchinskiy p 160–168 refs (See N67-35059 20-30)

N67-35053*# National Aeronautics and Space Administration, Washington, D. C.

CONVECTIVE STAR MODEL WITH NON-RIGID ROTATION

V. V. Porfir'yev *In its* Probl. of Astrophys. Aug. 1967 p 83–96 refs (See N67-35042 20-30)

The stationary rotation of stars is discussed. It is proved that stationary rotation is characterized by a decrease of angular velocity and equatorial slowing down on the surface of a star in the presence of sufficiently developed circulation. It is shown that such a law of rotation is not observed in real stars; therefore, it is necessary to consider rotation without circulation. The equations of star structure in the absence of circulation are derived. In this case the law of rotation is determined by the distribution of temperature and density in the star. The law of rotation for a star with a convective core and a radiative envelope is given. The angular velocity of rotation increases slowly towards the surface. Distribution of the angular velocity on the surface of such a star is similar to that observed for the Sun. Author

N67-35054*# National Aeronautics and Space Administration, Washington, D. C.

CATALOG OF PHOTOGRAPHIC MAGNITUDES OF COMPARISON STARS IN GLOBULAR CLUSTER M92

L. I. Paneva and E. S. Kheylo *In its* Probl. of Astrophys. Aug. 1967 p 97–102 refs (See N67-35042 20-30)

A catalog of magnitudes of 278 stars in the neighborhood of the globular cluster M92 is presented. The value of the internal error is $\pm 0^m.02$. A transitional formula of the photometric system into the international one is given. Author

N67-35055*# National Aeronautics and Space Administration, Washington, D. C.

VARIABLE STARS IN GLOBULAR CLUSTER M92

E. S. Kheylo *In its* Probl. of Astrophys. Aug. 1967 p 103–112 refs (See N67-35042 20-30)

The observations of six RR-Lyrae stars in M92 and the results of their evaluation are given. The periods are determined, and the variation of the period is found for one star. Author

N67-35056*# National Aeronautics and Space Administration, Washington, D. C.

CATALOG OF PHOTOVISUAL MAGNITUDES OF STARS IN THE REGION WITH CENTER $\alpha = 19^h$, $\delta = +11°$

V. I. Voroshilov *In its* Probl. of Astrophys. Aug. 1967 p 113–127 refs (See N67-35042 20-30)

A catalog is presented of photovisual magnitudes of 3440 stars, determined with a mean error of $\pm 0^m.04$. The International System is used. Author

N67-35057*# National Aeronautics and Space Administration, Washington, D. C.

SPATIAL DISTRIBUTION OF STARS IN THE REGION WITH CENTER ($\alpha = 18^h50^m$, $\delta = +5°$)

V. I. Voroshilov *In its* Probl. of Astrophys. Aug. 1967 p 128–137 refs (See N67-35042 20-30)

The structure of the Milky Way in the direction of the Sagittarius spiral arm is considered, along with the relation between the distribution of stars of different spectral types and the distribution of dust and neutral hydrogen. All the O-B2 type stars detected are located in a region with a very low density of absorbing matter and neutral hydrogen. The B8–A5 and gF8–K5 type stars tend to group in the region of dust clouds. For F and G dwarfs, this tendency is slight. The study of star distribution in a direction perpendicular to the galactic plane shows that the density maxima of O, B and A stars and late giants do not coincide with this plane. Also given is a partial picture of the structure of the Sagittarius spiral arm in Aquila. In order to obtain a more complete picture, observations of stars to 16^m in the region of the galactic equator and southern latitudes are necessary. Author

N67-35058*# National Aeronautics and Space Administration, Washington, D. C.

THE MILKY WAY IN THE CONSTELLATION AQUILA

G. L. Fedorchenko *In its* Probl. of Astrophys. Aug. 1967 p 138–159 refs (See N67-35042 20-30)

The results are given of a study of the Milky Way in the Rift. The study was performed on the basis of magnitudes and spectra of stars up to $12^m.0$–$12^m.5$. The results of other investigations are used. The special features of dust and stellar components, and their connections with one another and with neutral hydrogen are discussed. The link, consisting of early-type stars and dust clouds between the Carina–Cygnus and Sagittarius arms, is absent in longitudes 340°–20°, which is the mean feature of the investigated galactic region. Some considerations are given as to the position of the Sagittarius arm in the Northern sky. Author

N67-35059*# National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF THE EARTH'S ATMOSPHERIC TURBULENCE ON THE LIGHT COLLECTION OF TELESCOPES

I. G. Kolchinskiy *In its* Probl. of Astrophys. Aug. 1967 p 160–168 refs (See N67-35042 20-30)

The influence of the optical instability of the atmosphere on the quality of star focal images, made with telescopes having various diameters, is discussed. Estimations of the part of reduction to transatmospheric star brightness due to atmospheric turbulence are given. Author

N67-35071*# Bureau of Mines, Minneapolis, Minn. Twin Cities Mining Research Center.
MULTIDISCIPLINARY RESEARCH LEADING TO UTILIZATION OF EXTRATERRESTRIAL RESOURCES Annual Status Report, Fiscal Year 1967
1967 74 p refs
(NASA-Order R-09-040-001)
(NASA-CR-88161) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Experimental work is reported for various physical and engineering property data on lunar surface materials, the development of the Apollo lunar drills, and the planning of the Apollo lunar scientific experiments. Particular effort is placed on the study of data from lunar soft-lander and orbiter probes to establish the range of rock materials most likely to be encountered on the Moon. Also reported is a literature search related to the program's objectives. G.G.

N67-35074# Max-Planck-Institut für Physik und Astrophysik, Munich (West Germany).
QUASARS AND COSMOLOGY
P. Kafka May 1967 25 p refs
(MPI-PAE/ASTRO-2/67) CFSTI: HC $3.00/MF $0.65

Described is a procedure to evaluate information on quasars by correlating the space-time distribution of luminosities with other intrinsic properties. The array of luminosities is divided into classes and a matrix of classes is obtained for two independent luminosity model distributions. The number density of objects belonging to each class within certain intervals of redshift is then divided by the volume of spherical shells corresponding to each epoch in order to obtain the luminosity-function for optical and radio luminosities. It seems that the number density is rising towards lower radio luminosity, while the optical luminosity seems to be maximal at mean luminosities. G.G.

N67-35089* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A COMMENT ON THE INTERSTELLAR H_2 ABUNDANCE
D. A. Williams (NAS–NRC) and T. P. Stecher [1965] 4 p refs Submitted for publication
(NASA-TM-X-56961) CSCL 03B

Ways of increasing hydrogen concentrations in interstellar space, including production and destruction processes, are reviewed, and the stellar mass loss of alpha-Herculis is discussed. It is felt, assuming alpha-Herculis to have a typical mass loss rate, that all the mass lost is molecular hydrogen, and that the ejection process is a cold one. It is also considered that 0.25% of the interstellar hydrogen is molecular. N.E.N.

N67-35177# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
SYNTHESIS OF THE ANALYTICAL RESULTS OF OPTIMAL TRANSFERS BETWEEN KEPLERIAN ORBITS (TIME-FREE CASE) [SYNTHESE DES RESULTATS ANALYTIQUES SUR LES TRANSFERTS OPTIMAUX ENTRE ORBITERS KEPLERIENNES (DUREE INDIFFERENTE)]
Christian Marchal 1967 95 p refs In FRENCH; ENGLISH summary Presented at the Colloq. on Advan. Probl. and Methods for Space Flight Optimization, Liege, 19–23 Jun. 1967
(ONERA-TP-482(1967)) CFSTI: HC $3.00/MF $0.65

The study of economical transfer between Keplerian orbits has made progress these last years especially in the time free case which is exposed here. Three types of orbits are considered: hyperbolas, ellipses exterior to the attractive planet and ellipses intersecting the attractive planet (launching orbits). Conditions for the optimal utilization of a rocket are mentioned as well as the optimal transfers between different types of orbits (parabolas → arbitrary orbits, arbitrary orbits → parabolas, hyperbolas → ellipses and ellipses → hyperbolas) are listed. The end of the paper deals with the following points: practical point of view, some geometrical properties of the Keplerian orbits and further investigations. Author (ESRO)

N67-35182*# National Aeronautics and Space Administration, Washington, D. C.
HANDBOOK OF THE PHYSICAL PROPERTIES OF THE PLANET MARS
C. M. Michaux (Douglas Aircraft Co., Santa Monica, Calif.) 1967 173 p refs
(NASA-SP-3030) GPO: HC $0.70; CFSTI: MF $0.65 CSCL 03B

This handbook summarizes our present knowledge of the planet Mars, based on observational and theoretical studies. Information is included on the Martian orbit, configuration and seasons, mass, diameter and shape, rotation, surface gravity, mean density, internal structure, electromagnetic and particle fields, surface temperature, optical parameters, atmospheric composition, atmospheric structure, atmospheric circulation, clouds, blue haze, surface features, life, and satellites. R.N.A.

N67-35224*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DIFFERENTIAL CORRECTIONS APPLIED TO VINTI'S ACCURATE REFERENCE SATELLITE ORBIT WITH INCLUSION OF THE THIRD ZONAL HARMONIC
Harvey Walden and Stan Watson Washington, NASA, Aug. 1967 49 p refs
(NASA-TN-D-4088) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A differential method of orbit improvement utilizing observational data is presented for Vinti's spheroidal solution of the dynamical problem of unretarded artificial satellite motion about an oblate planet, recently modified so as to permit the exact inclusion of the effects of the third zonal harmonic term of the planet's gravitational potential field. The first-order Taylor's series expansion used for the equations of condition is fitted to observational values by an iterated least-squares process, producing successively smaller corrections to the orbital elements. A mean set of elements, conditioned by the observations, results for use in orbital predictions for intermediate time points or for later epochs. The differential coefficients in the conditional equations, applicable to any type of observational data, are derived analytically from the equations of the accurate reference orbit. The method of differential correction may be used for orbits of all inclinations, including equatorial and polar; both a first-order treatment and a lengthier, but more exact, second-order treatment for the periodic variables are given. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N67-34031*# General Dynamics/Convair, San Diego, Calif.
ANALYSIS AND DESIGN OF SPACE VEHICLE FLIGHT CONTROL SYSTEMS. VOLUME VII: ATTITUDE CONTROL DURING LAUNCH
Arthur L. Greensite Washington, NASA, Jul. 1967 134 p refs (Contract NAS8-11494)
(NASA-CR-828; GDC-DDE66-028) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This report, one of a series intended to illustrate methods used for the design and analysis of space vehicle flight control systems, is concerned with the short period dynamics of attitude control during launch. The general features of the attitude control problem are discussed, especially as it relates to the interaction with guidance and loads. A complete set of equations of short period dynamics is given. The autopilot design problem is then considered in detail. The general features of the salient dynamic modes are discussed, followed by a consideration of the usual techniques for providing stability augmentation. The influence of various nonlinear effects is examined, along with appropriate analytical methods. Approximate transfer functions and a complete computer simulation are discussed. R.N.A.

N67-34060# Utah Univ., Salt Lake City. Upper Air Research Lab.

ROCKET INSTRUMENTATION FOR AURORAL MEASUREMENTS—BLACK BRANT AC 17.604

David A. Burt Mar. 1967 65 p refs

(Contract AF 19(628)-4995)

(UU-67-1; SR-7; AFCRL-67-0295; AD-653992) CFSTI: HC $3.00/MF $0.65

The report details the instrumentation developed by the University of Utah for a Black Brant rocket designed to make multiple D-region measurements during an auroral absorption event. This rocket was launched from the Churchill Research Range in 1966, by Air Force Cambridge Research Laboratories. The instruments on the rocket were designed to measure the following: Electron density; Electron temperature; Plasma conductivity; Ion density; Energy deposition electron > 5 keV, proton > 60 keV; Lyman-alpha radiation; Auroral light, 3914 A; Auroral light wideband (4000-12,000 A); Vehicle potential; Bremsstrahlung X-rays (1-8 A). Author (TAB)

N67-34177*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

A TREATISE ON THE SURVEYOR LUNAR LANDING DYNAMICS AND AN EVALUATION OF PERTINENT TELEMETRY DATA RETURNED BY SURVEYOR I

F. Sperling and J. Garba 15 Aug. 1967 31 p refs

(Contract NAS7-100)

(NASA-CR-87421; JPL-TR-32-1035) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The lunar landing of a Surveyor spacecraft is investigated from the viewpoint of landing dynamics, which includes the dynamic behavior of the spacecraft as well as that of the lunar surface material during the landing process. A description is given of the landing gear design, the final descent and landing sequence, and the analytical and experimental qualification programs conducted. The evaluation of landing telemetry data concentrates on the Surveyor I mission, although preliminary results of Surveyor III are briefly discussed. In a parametric landing simulation study, the best agreement between analytical and flight data was found to be associated with a dynamic soil model having a bearing strength between 0 and 2 psi at the surface, and between 6 and 8 psi at a depth of 2 in., when penetrated by a Surveyor footpad. Author

N67-34193* Massachusetts Inst. of Tech., Cambridge. Center for Space Research.

THE DIGITAL SUBUNIT OF SUNBLAZER

Helmuth Hauck 10 Jul. 1967 108 p

(Contract NASr-249)

(NASA-CR-87411; CSR-TR-67-5) CSCL 22B

The digital subsystem consists of a code generator (Barker code) for modulating the main carriers, of subunits for timing the pulsed transmission of high power pulses, and of two data subunits for telemetry. Another main feature is the implementation with integrated MOS field effect transistor circuits, which reduces the consumed power and the packaging volume to a large extent. A general description of the function of all subunits and a detailed description of the MOS-FET integrated circuits are included. All subunits and their implementation are discussed in detail, and the radiation effects on the MOS-FETs and the proper shielding are discussed briefly. Author

N67-34212*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

QUALIFICATION EVALUATION OF THE PITCH CONTROL MOTOR FOR THE LAUNCH ESCAPE SYSTEM OF THE APOLLO SPACECRAFT PROGRAM

B. J. Lee and P. E. Cota, Jr. Washington, NASA, Aug. 1967 104 p refs

(NASA-TN-D-4068) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This paper is a summary of the qualification test phase (consisting of environmental testing and static test firing) of the Apollo pitch control motor test program; however, the paper also supplements the contractor's work by statistically evaluating the qualification static test data with regard to the specification requirements. The environmental testing portion of the qualification test program was conducted with a total of 14 pitch control motors divided into five environmental test groups—temperature cycling and vibration testing, temperature cycling and drop testing, accelerated aging, acceleration testing, and temperature cycle testing. The static test firing portion of the qualification test program was conducted using a total of 17 Apollo pitch control motors (10 environmentally tested motors and 7 motors not environmentally tested). These motors were divided into three prefire propellant temperature groups: 20°F (six motors), 70°F (four motors), and 140°F (seven motors). The motors were static test fired at a nominal pressure altitude of 13.7 psia. The results of the qualification test program investigation confirm that the pitch control motor is qualified for the Apollo Spacecraft Program. Author

N67-34238# Naval Ordnance Lab., White Oak, Md.

A PRELIMINARY STUDY OF THE MECHANISM OF WATER-ENTRY WHIP OF 20° CONE NOSED MODELS

John O. Gurney, Jr. 1 Aug. 1966 28 p refs

(NOLTR-66-148; Ballistics Res. Rept.-168; AD-650925) CFSTI: HC $3.00/MF $0.65

Preliminary experimental data are reported on the whip behavior of 20-degree cone nosed models with variable center of gravity and variable transverse moment of inertia launched at 45 degrees and at 105-135 feet per second. The results are compared with fundamental ideas and it is concluded that there is a high sensitivity of whip to initial pitch and that there may be a force distribution on the nose producing the effect of a couple during nose penetration. Author (TAB)

N67-34257*# Radio Corp. of America, Moorestown, N. J.

PHASE DIFFERENCE NAVIGATION SATELLITE STUDY Interim Scientific Report

Jun. 1967 526 p refs

(Contract NAS12-509)

(NASA-CR-87443) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Details of performance analysis and implementation of the navigation and traffic control system employing phase difference measurements are presented. The systems concepts are described, including traffic control surveillance, passive or self-navigation by user vehicles, and relative navigation. Estimates of potential vehicles, position fix accuracy requirements, and traffic densities are given for aircraft and marine users. The process of position determination is analyzed, and techniques are recommended for the distribution of satellite position data for manual navigation. A comprehensive simulation of error transformation of ranging from measurement errors into position fix errors is provided. A detailed analysis of system performance parameters for RF propagation and signal

processing are developed. It is concluded that the system can perform world-wide navigation/traffic control functions on a 24 hr/day basis for maximum traffic densities projected to 1975, and ground station, satellite, and user equipment requirements are within the present state-of-the-art. N.E.N.

N67-34317# General Electric Co., Philadelphia, Pa. Re-Entry Systems Dept.
PRE-TEST REPORT FOR MK 12 MOD 1 RE-ENTRY VEHICLE (TAPEWOUND SHIELD-STRUCTURE) FLIGHT PROOF TEST PROGRAM
L. J. Pasquinelli 26 Oct. 1966 19 p
(Doc.-66SD9101) CFSTI: HC $3.00/MF $0.65

The flight proof tests to be performed on the Mark 12 Mod 1 tape-wound carbon phenolic shield-structure are outlined. A mid section and an aft section scheduled for use in rocket exhaust thermo-structural testing are to be used. Data will be obtained on vibration, shock, and temperature–humidity–altitude environments. The instrumentation and the test facilities are mentioned, and the success or failure criteria are summarized. N.E.N.

N67-34401*# Hayes International Corp., Huntsville, Ala.
LAUNCH VEHICLE WIND AND TURBULENCE RESPONSE BY NONSTATIONARY STATISTICAL METHODS
James E. Bailey, John L. Palmer, and Ruric E. Wheeler Washington, NASA, Aug. 1967 137 p refs
(Contract NAS8-20344)
(NASA-CR-848; Rept.-1340) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The development of a nonstationary adjoint statistical algorithm for use in determining wind loading on a launch vehicle during ascent through the atmosphere is presented. The evolution of this algorithm included the development of a wind model shaping filter which reproduces the statistics of the winds as determined from Jimsphere soundings over Cape Kennedy. The wind model includes the nonstationarity of the winds and turbulence and the technique presented represents an excellent method for performing response and loading alleviation studies which is based on a sound theoretical foundation. Author

N67-34409# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MK 12 SOUNDING ROCKET (CANISTER TYPE) FLIGHT PROOF TESTS Final Test Report, 8 Jun.–25 Aug. 1966
M. Bongiovanni 31 Oct. 1966 37 p
(Doc.-66SD9144)

The Mark 12 sounding rocket (canister type) nose cone and payload were subjected to a series of flight proof tests during the period 8 June–25 August 1966. The environmental and functional tests consisted of an altitude test, a temperature–humidity test, a powered flight acceleration test, a vibration and shock test, a system test, a canister chaff dispersion test, and a programmer inertia switch test. All system components were functioned in proper sequence and operated within design limits in accordance with the sounding rocket flight proof specification S0040-01-0026A. During flight proof testing, specification changes were required to reflect more realistic vibration and shock levels and a clarification in wordage was also required. Author

N67-34431*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
NIMBUS METEOROLOGICAL SATELLITE INTEGRATION AND TESTING MATERIALS REPORT NO. 8
T. Neville Jul. 1965 53 p refs
(Contracts NAS5-978; NAS5-1347)
(NASA-CR-87481; Doc.-65SD4410) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Various material and environmental investigations, failure analyses, and quality control practices are discussed. Work included redesign and evaluation of the solar array drive (SAD) to incorporate greater potential torque capability, and to effect significant motor bearing temperature reduction by using reduced electrical power input, larger rotor clearance and high rotor surface emissivity, and a large thermal conductive path for the stator. Other SAD work included reevaluating silicone grease lubricants against other lubricants, temperature measurements on the ac motor bearing, thin film grease evaporation tests, and dry film lubricant investigations. Outgassing tests were conducted on silicone rubbers to determine if a camera lens contamination problem existed from use of these rubbers in Nimbus video targets. Results show no evidence of contamination. Infrared scanner stimulator tests indicate the probability is low that significant outgassing condensation problems exist in the stimulator. Harness wire assembly investigations reveal that heat and pressure were the major factors in insulation degradation. E.C.

N67-34452*# General Dynamics Corp., San Diego, Calif.
ANALYSIS AND DESIGN OF SPACE VEHICLE FLIGHT CONTROL SYSTEM. VOLUME XIV: LOAD RELIEF
Robert D. Harris Washington, NASA, Aug. 1967 84 p refs
(Contract NAS8-11494)
(NASA-CR-833; GD/C-DDE67-003) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The load-relief autopilot and its application to launch vehicle control are described. The load-relief autopilot is defined as any autopilot using an additional feedback channel or channels on a conventional autopilot baseline to alleviate vehicle loading, trajectory dispersions, or a combination of both. The load-relief autopilot is primarily used during the maximum dynamic pressure region of flight when wind velocities produce the largest vehicle bending moments. However, the time usage is dependent on the selected control law. An introduction to control laws is presented, the advantages and disadvantages of some typical control laws are discussed, and a resume of control laws investigated by industry and governmental institutions is given. Five steps for the analysis of load-relief autopilots are outlined along with detailed examples. R.N.A.

N67-34453*# General Dynamics Corp., San Diego, Calif.
ANALYSIS AND DESIGN OF SPACE VEHICLE FLIGHT CONTROL SYSTEMS. VOLUME III: LINEAR SYSTEMS
Arthur L. Greensite Washington, NASA, Jul. 1967 228 p refs
(Contract NAS8-11494)
(NASA-CR-822) CFSTI: HC $3.00/MF $0.65 CSCL 09C

Recent developments in general linear control theory and various refinements in standard methods are summarized. The fundamental techniques for analyzing linear continuous systems are discussed in their order of chronological development, beginning with the classical methods of determining whether the characteristic equation for a given system contains roots with positive real parts. The frequency response methods of Bode and Nyquist and their applications to aerospace systems are treated in detail. The prominent facets of the root-locus method are considered with emphasis on the qualitative features of the system response obtainable by this method. Recent developments for the stability analysis of systems expressed in the state variable format are summarized. The concepts of observability and controllability are discussed to clarify the relation between a system expressed in state-variable form and one expressed in transfer-function form. The invariance principle, a novel method for rendering a system insensitive to extraneous disturbances, is discussed along with problems in its application to a launch vehicle autopilot. R.N.A.

N67-34545*# General Dynamics/Convair, San Diego, Calif.
ANALYSIS AND DESIGN OF SPACE VEHICLE FLIGHT CONTROL SYSTEMS. VOLUME XV: ELASTIC BODY EQUATIONS
Arthur L. Greensite Washington, NASA, Aug. 1967 109 p refs
(Contract NAS8-11494)
(NASA-CR-834; GD/C-DDE65-025) CFSTI: HC $3.00/MF $0.65 CSCL 22B

General equations of motion for an unrestrained elastic body and beam equations are considered in relation to the analysis and design of space vehicle flight control systems. Free vibrations in a vacuum, forced vibrations and natural modes, and energy methods are discussed for the motion equations; and free vibrations of uniform beams, forced vibrations of nonuniform beams, orthogonality properties with shear and rotary inertia, and numerical methods are reported for the beam equations. Other procedures described are the lateral vibrations of a launch vehicle, flexible body motion of the vehicle, and autopilot equations. Clustered boosters, sloshing in flexible tanks, and attached masses and component modes are discussed. M.W.R.

N67-34548*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SCIENTIFIC RESULTS OF PROJECT PEGASUS. Interim Report
3 Jul. 1967 62 p refs
(NASA-TM-X-53629) CSCL 22B

Project Pegasus, which has the primary objective of measuring the near-earth meteoroid environment, has provided observational results far beyond the mission for which it was originally conceived. It has provided not only observational data on meteoroid punctures but also on Van Allen belt radiations, on earth albedo, on the solar constant, on orbital and gyroscopic motions of rigid bodies, on the degradation of surface coatings under space environmental conditions, on thermal control systems, and on the lifetimes of electronic components in space operations. Author

N67-34581 Defence Research Board, Ottawa (Ontario).
ALOUETTE 1 IONOSPHERIC DATA N(h), VOLUME 4, NO. 2
1 Jun. 1967 334 p
CFSTI: HC $3.00/MF $0.65

Tables of electron density profiles for selected groups of ionograms are presented. The satellite orbit and radio frequency changes are given, and the methods of calculation and analysis are outlined. N.E.N.

N67-34613*# Tennessee Univ., Knoxville. Dept. of Electrical Engineering.
A MATHEMATICAL MODEL FOR A SPACE VEHICLE THRUST VECTOR CONTROL SYSTEM
Z. Thompson and J. C. Hung 24 Aug. 1967 83 p refs
(Grant NsG-351)
(NASA-CR-87448; SR-15) CSCL 22D

Equations for the various components of the thrust vector control system are developed, and the overall mathematical model is used to design a TVC system that uses conventional flow valves and actuators. For multiple engine control, a hydraulic fluid system is considered most desirable because it eliminates some of the difficulties encountered by hardware tolerances of different engines. While the presented TVC system does not solve all actuation problems, it has much to offer for large mass gimbal systems and the dynamic shaping network used permits some latitude in choosing other components of the TVC system. M.W.R.

N67-34623*# National Aeronautics and Space Administration, Washington, D. C.
2ND BIOSATELLITE TO STUDY BIOLOGY OF SPACE FLIGHT
21 Aug. 1967 44 p
(NASA News Release-67-217) Available from the Scientific and Technical Information Division CSCL 22B

A general description of the Biosatellite B mission is given followed by details of the spacecraft systems and subsystems, radiation and biological experiments, flight plan, Delta launch vehicle characteristics, nominal flight events, tracking and recovery, and flight sequence. R.N.A.

N67-34694*# Sperry Phoenix Co., Ariz.
STUDY OF APPLICATIONS OF A TRACKING FILTER TO STABILIZE LARGE FLEXIBLE LAUNCH VEHICLES
David C. Cunningham and Walter T. Higgins, Jr. Aug. 1967 92 p refs
(Contract NAS8-20080)
(NASA-CR-87486; LJ-1201-0797) CSCL 22B

Application of adaptive tracking filters to launch vehicle bending mode stabilization has been studied using two boosters, the Saturn IB-201 and the Saturn V-501. Results of these studies indicate that for certain structural bending mode characteristics, the tracking filter can be used to obtain better stability margins than a fixed filter. One such case occurs with the Saturn V-501, and a tracking filter system was designed and evaluated for this vehicle. With nominal bending parameters, the vehicle response to the trajectory simulation wind profile was the same using the tracking notch system and the conventional system. The notch system, however, tolerated greater increases in the bending mode slopes with nominal and off-nominal bending frequencies. Author

N67-34792*# TRW Systems, Redondo Beach, Calif.
MISSION ORIENTED STUDY OF ADVANCED NUCLEAR SYSTEM PARAMETERS, PHASE IV, VOLUME II Final Report, May 1965–Dec. 1966
A. R. Chovit and L. D. Simmons Dec. 1966 142 p refs
(Contract NAS8-5371)
(NASA-CR-87488; TRW-01977-6005-R000, Vol. 2) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Details are presented on the mission, trajectory, and vehicle analyses of manned Mars stopover missions. These included trade-offs, mission mode comparisons, and sensitivity investigations of the Venus swingby mode. Vehicle and engine sizing computations were performed to evaluate launch and abort operations and constraints, and existing computer programs were modified to incorporate additional mission concepts and parameters. The more salient results indicate: (1) The conjunction mission analysis showed that the long outbound, short inbound trajectory yielded the minimum weight vehicle. (2) For all missions analyzed, aborts were generally possible during the first third to first half of the outbound leg duration. (3) For all mission types and launch opportunities considered in the launch azimuth constraint analysis, launches are possible if the nominal allowable firing sector (departure declination limit of 52.4°) can be used. M.G.J.

N67-34882*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
A COMPENDIUM OF NASA AEROBEE SOUNDING ROCKET LAUNCHINGS FOR 1966
Jon R. Busse, Merrill T. Leffler, George E. Kraft, and Paul S. Bushnell, Jr. Washington, NASA, Jul. 1967 80 p refs
(NASA-TN-D-3912) CFSTI: HC $3.00/MF $0.65 CSCL 22D

Information on the 28 NASA Aerobee sounding rocket launchings in 1964 is summarized. Included are vehicle and

subsystem performance data, descriptions of the various Aerobee rockets employed and experiments flown, and brief analyses of malfunctions. Information on each flight is presented in tabular form for purposes of comparison in appendices and cross referenced to the text. Author

N67-34940*# General Dynamics/Convair, San Diego, Calif.
ANALYSIS AND DESIGN OF SPACE VEHICLE FLIGHT CONTROL SYSTEMS. VOLUME IV—NONLINEAR SYSTEMS
Arthur L. Greensite Washington, NASA, Jul. 1967 179 p refs
(Contract NAS8-11494)
(NASA-CR-823; GD/C-DDE65-056) CFSTI: HC $3.00/MF $0.65
CSCL 09C

This monograph discusses a variety of techniques available for the analysis of nonlinear control systems. Consideration is given to those techniques which have proved most useful in the analysis of launch vehicle control systems. Well established techniques such as phase plane and describing function are treated from first principles together with extensive application to problems of flight control. Various refinements are described. A substantial portion of the discussion deals with the Lyapunov theory of stability with emphasis on flight control applications. While this technique is still under active development, its broad features are well established, and it has proved useful in providing insight to previously obscure areas. The general theme of this volume is that of displaying the features of nonlinear flight control problems obtainable by judicious application of modern nonlinear control theory, indicating both the power and potential of these methods together with a discussion of limitations and areas for future research. Author

N67-34950# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
THE AERODYNAMIC PROBLEMS OF THE SOUNDING-ROCKET VEHICLES [LES PROBLEMES AERODYNAMIQUES DES FUSEES SONDES]
Rene Ceresuela 1967 28 p refs In ENGLISH and FRENCH
Presented at the A.I.A.A. Sounding-Rocket Vehicle Technol. Specialist Conf., Williamsburg, Va., 27-28 Feb. 1967
(ONERA-TP-441(1967)) CFSTI: HC $3.00/MF $0.65

The new problems raised by the increase in speed and altitude of the sounding vehicles are discussed. Stabilization by conventional fins is first reviewed with regard to the interactions between the fins of successive stages, to the transonic difficulties and to the hypersonic loss of efficiency. The method of stabilization by conical flares and the theoretical prediction of their efficiency are then examined; the latter is shown to be difficult and testing in hypersonic wind tunnels is therefore mandatory, as is the examination of the results—from the point of view of Reynolds number effects—to predict the flight stability. The interactions between the propulsive jets and the external stream are discussed under the aspect of plume induced separation, and of possible troubles during the stage separation. Wind tunnel tests are described; the results help in predicting the critical flight-events. Other possible interactions between the jet flow, the external flow and the sounding experiments are indicated. Author (ESRO)

N67-34983# Junkers Flugzeug- und Motorenwerke A. G., Munich (West Germany).
HIGHLY ECCENTRIC ORBITING SATELLITE [DER HEOS-A SATELLIT]
Guenter Schell [1966] 9 p Presented at the DGRR-Symp. Satelliten-Technik II, Munich, 8 Dec. 1966
(Rept.-66-124) CFSTI: HC $3.00/MF $0.65

Design criteria and an outline of the development are presented for the ESRO-sponsored Highly Eccentric Orbiting Satellite (HEOS-A). The mission of the satellite is research in interplanetary physics, particularly intensive measurements of magnetic fields, cosmic radiation, and solar winds. An improved Delta (DSV 3-E) is planned as the launch vehicle. Purpose and configurations of the satellite's eight experiments are described. Briefly discussed are the communication system, design philosophy of the subsystems, structural characteristics, thermal control, sensor groups, orbital data, and satellite stability and control. Transl. by K.W.

N67-35013*# Bell Aerosystems Co., Buffalo, N. Y.
STUDY OF CERAMIC HEAT SHIELDS FOR LIFTING REENTRY VEHICLES
J. N. Krusos Washington, NASA, Aug. 1967 99 p refs
(Contract NAS1-5370)
(NASA-CR-861) CFSTI: HC $3.00/MF $0.65 CSCL 22B

An analytical and experimental study was conducted to determine and assess radiative ceramic heat shield designs for manned lifting entry vehicles. Porous forms of ceramics were selected to provide advantageous insulation and weight characteristics. Candidate materials and their appropriate porous structure were determined through thermal stress analyses, heat transfer studies, and thermal shock tests which simulated the most severe heating conditions for representative vehicle reentry trajectories. The materials which demonstrated repetitive thermal shock capability were incorporated into heat shield designs. Optimization studies were applied to define minimum weight shields for the three most promising ceramic materials. Statistical studies were made to describe approaches for understanding the strength properties of highly porous refractory bodies, their response to mechanical loads, and their apparent marked insensitivity to notches and flaws as compared to dense brittle materials. The state-of-the-art of manufacturing ceramics and inspection techniques in relation to vehicle needs, including repeated flight capability, were reviewed. The ceramic heat shield concepts were compared with ablative shields with respect to cost, weight, reliability, and other aspects. Author

N67-35021 European Space Vehicle Launcher Development Organization, Paris (France).
ELDO TECHNICAL REVIEW, VOLUME 2, NO. 1
Paris, Gauthier-Villars, 1967 78 p refs In ENGLISH and GERMAN
CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. THE DETERMINATION OF THE THERMAL CONDUCTIVITY OF THE SPECIFIC HEAT AND THE DENSITY (GROSS DENSITY) OF INSULANTS FOR ROCKET TANKS FILLED WITH LIQUID HYDROGEN. PART I: DESCRIPTION OF MEASURING METHOD B. Koglin and W. F. Zimni (Entwicklungsring Nord) 26 p refs (See N67-35022 20-33)

2. THE ITALIAN EARTH STATION FOR SATELLITE COMMUNICATIONS AT FUCINO P. Fanti 22 p (See N67-35023 20-07)

3. STABILITY OF A GEOSTATIONARY SATELLITE IN THE TERRESTRIAL FIELD E. Cambi 26 p refs (See N67-35024 20-31)

N67-35024 European Space Vehicle Launcher Development Organization, Paris (France).
STABILITY OF A GEOSTATIONARY SATELLITE IN THE TERRESTRIAL FIELD
E. Cambi *In its* ELDO Tech. Rev. Vol. 2, No. 1 1967 26 p refs (See N67-35021 20-31)

A fairly complete survey of the stability of a geostationary satellite is given, in the presence of the most significant asphericities of the geopotential field (oblateness, equatorial ellipticity, pear-shapedness. The problem of stability is approached in terms of

Liapunov's theory but is solved, preferably, through a direct, approximated integration of the differential equations of the relative motion. Author (ESRO)

N67-35035*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AEROELASTIC LOAD GROWTH EFFECTS ON SATURN CONFIGURATIONS
James G. Papadopoulos 14 Jul. 1967 39 p refs
(NASA-TM-X-53634) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The effects of aerodynamic loads induced by static aeroelasticity are analyzed for the Saturn configurations. This aeroelastic load growth is shown, for any given Mach number, to increase at an accelerated rate with increases in dynamic pressure. During the period of high dynamic pressure, the Saturn control requirements due to aeroelastic effects are significant. The unexplained external body moments recorded during the Saturn I Block II flights are correlated to aeroelastic load growth. Local aerodynamic bending moments are increased at a time in flight when the vehicle loadings are already large and near design limits. This aeroelastic load growth is additional to that of flexible bending mode dynamics and should be included when analyzing wind profiles for vehicle loadings. Author

N67-35142# Joint Publications Research Service, Washington, D. C.
A CURSORY SURVEY OF ROCKET DEVELOPMENT IN COMMUNIST CHINA
Jung-sheng Huang *In its* Transl. on Communist China's Sci. and Technol., no. 386 13 Jul. 1967 p 1–13 refs Transl. into ENGLISH from Chin Jih Ta Lu (Nationalist China), no. 241, 1 Oct. 1965 p 2–7 (See N67-35141 20-34)

The state-of-the-art of rocket research and development in Communist China is discussed. A review of scientists working in the field, technical literature, facilities, rocket testing sites, and newspaper reports is presented. Opinions of the author on the rocket capabilities of the country, and of the rate of progress in rocket technological development by the country, are given. L.S.

N67-35169*# General Dynamics/Convair, San Diego, Calif.
ANALYSIS AND DESIGN OF SPACE VEHICLE FLIGHT CONTROL SYSTEMS. VOLUME IX—OPTIMIZATION METHODS
Arthur L. Greensite Washington, NASA, Jul. 1967 189 p refs
(Contract NAS8-11494)
(NASA-CR-828; GDC-DDE66-026) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The essential mathematical features of the basic optimization techniques used in optimal control theory are described. The simplest optimization problems expressed in the classical variational calculus format are considered followed by a discussion of the classical theory limitations that motivated some of the modern techniques, such as the maximum principle, gradient methods, and dynamic programming. The basic results embodied in variational calculus, the maximum principle, and the gradient method are shown to be necessary consequences of the principle of optimality in dynamic programming. Standard solutions to linear problems, norm-invariant systems, and optimal trajectories are described together with typical aerospace applications, including lunar soft landing, optimal control of booster vehicles, and optimal reentry from orbit. R.N.A.

N67-35239* Scientific Translation Service, La Canada, Calif.
ROCKET FLIGHT
Rudolf Nebel Aug. 1967 32 p Transl. into ENGLISH of the book "Raketenflug" Berlin, Raketenflugverlag, 1932 p 1–47
(Contract NASw-1496)
(NASA-TT-F-11173) CSCL 19G

The history of rocket flight is traced from its beginning up through 1932. Some of the earlier applications of rockets, publications on the subject, and pioneers in the field are mentioned. Rocket launching facilities and experiments, principles and theories of rocket propulsion, the properties of various propellants, and such problems as nozzle materials and flight stability are discussed. The prospects of a manned rocket flight are considered along with the effects of such a flight on man, the recovery of a manned rocket by parachute, the description of a manned rocket, and its future applications. R.N.A.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N67-34017 National Aeronautical Lab., Bangalore (India).
STRESSES AROUND AN ELLIPTIC HOLE IN A CYLINDRICAL SHELL
M. V. Vedavyasa Murthy Mar. 1967 27 p refs
(NAL-TN-3)

A theoretical analysis is presented for the membrane stresses around an elliptic hole in a long, thin circular cylindrical shell with the major axis of the hole inclined at an arbitrary angle to the axis of the shell. The analysis has been carried out for uniform normal internal pressure and axial tension. The method of solution involves a perturbation in a curvature parameter and the results obtained are valid, if the hole is small in size compared to the shell. A formula, from which the membrane stress concentration at the hole can be directly calculated, is presented. If one of the principal axes of the hole is parallel to the shell axis, it is found that for any state of biaxial stress in the shell, there exists a certain value of eccentricity of the ellipse for which the membrane stresses are constant all along the boundary of the hole. Author

N67-34030 California Univ., Berkeley. Structural Engineering Lab.
REFINED FINITE ELEMENT ANALYSIS OF LINEAR AND NONLINEAR TWO-DIMENSIONAL STRUCTURES: APPENDICES
Carlos A. Felippa Oct. 1966 124 p
(Grant NSF GK-75)
(SESM-66-22a)

The appendices contain constitutive equations for linear elastic materials, a comparison between different types of quadrilaterals assembled with triangular elements, a computer program written in Fortran IV for solving general plane stress or plane strain static linear elastic problems using linear strain triangles combined to form an efficient mesh generating unit, and a computer program written in Fortran IV for the step-by-step displacement analysis of elastoplastic plane stress problems using linear strain triangles as finite elements. R.N.A.

N67-34036 National Physical Lab., Teddington (England). Aerodynamics Div.
THE INVESTIGATION OF THE AEROELASTIC BEHAVIOR IN STEADY WINGS OF THE PINNACLES OF THE METROPOLITAN CATHEDRAL, LIVERPOOL

D. E. Walshe Apr. 1966 16 p refs
(NPL-AERO-1190)

Aeroelastic models of three of the Cathedral pinnacles were built and tested in a wind tunnel. The tests were made to examine the possibility of oscillations of the pinnacles due both to self-induced vortex excitation and to the buffeting effect of the wake of windward pinnacles. Full-scale values of amplitudes of oscillation occurring within a wind-speed range of 0 to 60 miles/h were deduced from the results. It is not expected that serious oscillations of the pinnacles due to the action of either vortex shedding or of buffet will occur within the wind-speed range covered by the tests. Author

N67-34048 National Aeronautical Lab., Bangalore (India).
STRESS IN A CONICAL SHELL WEAKENED BY A CIRCULAR HOLE
A. N. Guz Jan. 1967 12 p refs
(NAL-TT-1)

Expressions are developed for the stresses and stress distributions in conical shells. The general case is considered, and applications are made to the case of basic stress with axial tension and uniform internal pressure, and to the case of a conical shell under axial tension and supported by a balancing force at the other edge of the shell. N.E.N.

N67-34085# Aeronautical Research Inst. of Sweden, Stockholm.
CREEP DEFORMATION AND BUCKLING OF A CIRCULAR CYLINDRICAL SHELL UNDER AXIAL COMPRESSION
Åke Samuelson 1967 27 p refs
(FFA-R-108) CFSTI: HC $3.00/MF $0.65

In a recent paper a theory of elastic deformation and secondary creep of a circular cylindrical shell under axisymmetrical loads was derived, and an approximate criterion for buckling was proposed. The theory was based on the "*I*-membrane" analogy, and numerical solutions were derived for the special case of a "double-membrane" shell. In the present report, the general equations were solved for an arbitrary, odd number of membranes and the results were compared with those of the previous report. The double-membrane analogy yields an over-estimate of the deflection and stress rates, but the effect on the creep buckling time as calculated from the approximate method was small in comparison with the scatter normally obtained at creep buckling tests. The double-membrane shell provides sufficiently accurate results for practical use. However, if a higher degree of accuracy is wanted, the 3-flange model yields a very close approximation to the solution provided by a multi-membrane shell. Creep buckling experiments on thin aluminium-alloy cylinders under various stress levels showed that the number of circumferential lobes developed on collapse decreases with a decreasing load level, and at a very low axial mean stress an axisymmetrical buckling configuration was noted. Author

N67-34100# Aeronautical Research Inst. of Sweden, Stockholm.
CREEP DEFORMATION AND BUCKLING OF A COLUMN WITH AN ARBITRARY CROSS SECTION
Åke Samuelson 1967 31 p refs
(FFA-R-107) CFSTI: HC $3.00/MF $0.65

The general equations for a column with an arbitrary cross section, subjected to secondary creep, were derived, using a "multi-flange" model in order to take into account and to predict a non-linear stress distribution. The equations were solved numerically by means of finite difference methods. The maximum deflection was found to approach large values within a short interval of time, thus defining exactly the critical time. The shape of the cross section was found to have a significant influence on the creep buckling time and for a non-symmetric section, the direction of buckling was also of importance. Comparisons with other theories based on similar assumptions showed good agreements. The results of an experimental investigation were reported, and comparisons with the theory were carried out. Although the number of tests was rather limited, the results seemed to confirm the predictions provided by the theory. The block diagram and Fortran IV program for the numerical treatment are given in the appendix. Author

N67-34175# David Taylor Model Basin, Washington, D. C.
IMPACT STRENGTH AND RESPONSE OF PROTECTED BRITTLE MODELS OF DEEP SUBMERGENCE STRUCTURES
Stephen Zilliacus and Harry P. Hashmall Apr. 1967 89 p refs
(DTMB-2314; AD-654165) CFSTI: HC $3.00/MF $0.65

Hemispherical shell models of deep-submergence structures and full-thickness plate (brittle) specimens protected by viscoelastic strain-attenuating material (Adiprene) were subjected to impact by spherical faced projectiles weighing from less than 0.1 to 1100 lb at velocities up to 30 ft/sec. Maximum tensile strain amplitudes in shells were reduced by a factor of 10 or better and contact failures were eliminated by the use of Adiprene. Maximum tensile strains at failure were from 1000 to 2300 micro-in/in for annealed glass plates, and from 3400 to 5800 micro-in/in for chemically strengthened (Herculite) glass plates; glass-reinforced plastic plates could not be damaged (except for crazing cracks between parallel adjacent fibers on the tension surface). Scaling relationships and empirical strain functions for predicting maximum tensile strains in large prototype shells were developed. Data and empirical functions were checked against impact and shell theories of Hertz and Reissner with fairly good agreement resulting. Author (TAB)

N67-34189# Aeronutronic, Newport Beach, Calif.
MECHANICAL BEHAVIOR OF FIBER-REINFORCED COMPOSITE MATERIALS Annual Report, Dec. 1965–Dec. 1966
Donald F. Adams, Douglas R. Doner, and Rodney L. Thomas Wright-Patterson AFB, Ohio. AF Mater. Lab. May 1967 150 p refs
(Contracts AF 33(615)-2180; AF 33(615)-5198)
(U-4093; AR-2; AFML-TR-67-96; AD-654056) CFSTI: HC $3.00/MF $0.65

It is generally agreed that a unidirectional composite is the fundamental unit from which composite structures are constructed. By subjecting this material to three separate loading conditions, that is, axial, transverse, and shear loadings, the basic stiffness and strength properties of the composite can be predicted in terms of the material and geometric properties of the constituents. These micromechanics analyses are presented, along with a detailed presentation of numerical results and a discussion of their practical significance. Analytical results have been compared with other analyses and with experimental data generated during this investigation. In addition, a preliminary discussion is given to the cyclic fatigue behavior of unidirectional composites. An S glass-epoxy system has been utilized in tests to date. Properties of boron-epoxy composites, including cross-ply and angle-ply laminate subjected to uniaxial tension, have been experimentally determined and results compared with analytical predictions. The satisfactory agreement obtained supports the assumption that the analysis, orginally verified for glass-epoxy composites, is equally valid for boron-epoxy systems. Author (TAB)

N67-34206# Catholic Univ. of America, Washington, D. C. Stress Analysis Lab.
STRAINS AND STRESSES IN MATRICES WITH INSERTS
A. J. Durelli, V. J. Parks, H. C. Feng, and F. Chiang May 1967 134 p refs
(Contract Nonr-2249(06))
(Rept.-12; AD-653721) CFSTI: HC $3.00/MF $0.65

This paper is a contribution to the experimental stress analysis of composite structures made of a matrix reinforced with fibers

The analysis is conducted in oversize transparent models in which the matrix is cast around inserts of different rigidities. The manufacturing of the models is described. Two- and three-dimensional photoelasticity are used for the analysis. Stresses and strains along the interfaces, and near the fiber ends, for different fiber end configurations, are studied in detail. Bonded and unbonded interfaces are analyzed. Two loading conditions are considered: restrained shrinkage and mechanically applied loading. Several of the difficulties encountered in the analysis are pointed out. The method developed will have application in the fields of fiber reinforced plastic structures, whisker reinforced metals, auto tires, ceramics and reinforced concrete, among others. Author (TAB)

N67-34217*# Alabama Univ., University. Bureau of Engineering Research.
A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF SHEAR LAG IN STIFFENED SHELLS AND THE STRESS ANALYSIS OF CONE FRUSTUMS AND SEGMENTS Final Report
May 1967 412 p refs
(Contract NAS8-20164)
(NASA-CR-87445) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Studies were conducted in two separate and distinct areas of structural analysis. In the first area of study, analyses of orthotropic conical shells including conical segments and conical frustums under various loadings were performed that accounted for the bending moments introduced by deformations prior to buckling. In the second area of study, the effect of shear lag on the stress distribution in integrally stiffened panels including panels with cutouts, tapered stiffeners and an unstiffened length was investigated both experimentally and analytically. Author

N67-34247# Brown Univ., Providence, R. I. Div. of Engineering.
A PATH INDEPENDENT INTEGRAL AND THE APPROXIMATE ANALYSIS OF STRAIN CONCENTRATION BY NOTCHES AND CRACKS
James R. Rice May 1967 49 p refs
(Contract ARPA SD-86)
(E39; AD-653716) CFSTI: HC $3.00/MF $0.65

An integral is exhibited which has the same value for all paths surrounding a class of notches in two-dimensional deformation fields of linear or non-linear elastic materials. The integral may be evaluated almost by inspection for a few notch configurations. Also, for materials of the elastic-plastic type (treated through a deformation rather than incremental formulation), with a linear response to small stresses followed by non-linear yielding, the integral may be evaluated in terms of Irwins stress intensity factor when yielding occurs on a scale small in comparison to notch size. On the other hand, the integral may be expressed in terms of the concentrated deformation field in the vicinity of the notch tip. This implies that some information on strain concentrations is obtainable without recourse to detailed non-linear analyses. Such an approach is exploited here. Applications are made to: Approximate estimates of strain concentrations at smooth ended notch tips in elastic and elastic-plastic materials, A general solution for crack tip separation in the Barenblatt-Dugdale crack model, leading to a proof of the identity of the Griffith theory and Barenblatt cohesive theory for elastic brittle fracture and to the inclusion of strain hardening behavior in the Dugdale model for plane stress yielding, and An approximate perfectly plastic plane strain analysis, based on the slip line theory, of contained plastic deformation at a crack tip and of crack blunting. Author (TAB)

N67-34258* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FAMSUB: A COMPUTER PROGRAM FOR DETERMINING THE FREQUENCIES AND MODE SHAPES OF UNIFORM BEAMS
Jerry F. Kuzanek Jul. 1967 50 p refs
(NASA-TM-X-55877; X-320-67-299) CSCL 20K

FAMSUB is a digital computer program, written in double precision FORTRAN IV for the IBM 7094 computer, which determines the transverse natural frequencies and mode shapes of uniform beams subjected to any of the following boundary conditions: simply supported, cantilever, simply supported–free, simply supported–clamped, free–free, and clamped–clamped. The frequency and modal equations which FAMSUB solves are derived from the Timoshenko theory, which accounts for bending, rotary inertia, and shear flexibility during the transverse vibrations of uniform beams. Options provided for deleting the terms in these equations account for rotary inertia, shear flexibility, or both. Author

N67-34268 California Univ., Berkeley. Structural Engineering Lab.
REFINED FINITE ELEMENT ANALYSIS OF LINEAR AND NONLINEAR TWO-DIMENSIONAL STRUCTURES
Carlos A. Felippa Oct. 1966 232 p refs
(Grant NSF GK-75)
(SESM-66-22)

A systematic procedure to construct polynomial displacement fields based on the use of interpolation formulas in natural coordinates is applied to plane triangles of linear elastic material using the first three complete polynomial expansions. Geometrically and physically nonlinear problems are formulated in the general form of a step-by-step matrix displacement analysis by means of a incremental variational principle. The derivation of geometric stiffness matrices for finite displacement and stability analysis and of incremental conventional stiffnesses for elastoplastic material is carried out for arbitrary three-dimensional elements and then specialized for plane stress triangles. Digital computer programs for the linear strain triangle are described and examples of application presented. Author

N67-34346# Ballistic Research Labs., Aberdeen Proving Ground, Md.
INTERFEROMETRIC MEASUREMENT OF DISPLACEMENTS DURING WAVE PROPAGATION IN SOLIDS
John H. Suckling and John T. Frasier Apr. 1967 56 p refs
(BRL-R-1362; AD-653635) CFSTI: HC $3.00/MF $0.65

A program was designed to demonstrate and evaluate the use of streak interferometry as a method for collecting temporally and spatially resolved transient deformation data on the surfaces of metallic solids. It is proposed that the technique has an important application in the establishment of constitutive relationships for solids transmitting elastic-plastic waves. The study showed that the technique can resolve displacement histories with times as short as 70 nanoseconds and measure surface velocities as large as 80 inches per second. These capabilities appear adequate for the intended applications. Representative data are shown and analyzed. Author (TAB)

N67-34411*# General Dynamics/Convair, San Diego, Calif.
ANALYSIS AND DESIGN OF SPACE VEHICLE FLIGHT CONTROL SYSTEMS. VOLUME XIII: ADAPTIVE CONTROL
Arthur L. Greensite Washington, NASA, Aug. 1967 80 p refs
(Contract NAS8-11494)
(NASA-CR-832; GD/C-DDE67-002) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A critical evaluation of the virtues and limitations of several types of bending mode adaptive techniques is presented. Each method is discussed with reference to a mathematical model. The Whitaker (MIT), and Tutt and Weymeyer systems for adaptive control are examined by these model reference procedures. Virtual slope methods examined include gyro blending and phasor cancellation. Notch filter methods examined include spectral

identification filtering and adaptive tracking filtering. Also discussed are a digital adaptive filter and frequency independent signal processing. L.S.

N67-34429# National Research Council of Canada, Ottawa (Ontario).
ON APPLYING FINITE ELEMENTS TO PANEL FLUTTER
Mervyn D. Olson Mar. 1967 26 p refs
(LR-476; NRC-9642) CFSTI: HC $3.00/MF $0.65

A finite element dynamic stiffness matrix for two-dimensional panel flutter calculations is presented. The results are applied to a simply supported and a clamped panel, to predict flutter boundaries and flutter modes. A comparison with the exact solutions showed that extremely accurate approximations to both flutter boundaries and modes could be obtained with only a few elements. Author

N67-34437 Royal Aircraft Establishment, Farnborough (England).
THE FATIGUE STRENGTH CHARACTERISTICS OF A DISTRIBUTED FLANGE WING STRUCTURE (BRITANNIA TYPE 100)
W. H. Morgan Oct. 1966 84 p
(RAE-TR-66315)

The results of a fatigue test on a distributed flange wing structure are given. The cyclic loading program simulated the conditions of atmospheric turbulence in climb, cruise and descent and also included the ground-air-ground cycle. After an initial period free of defects, fatigue cracks commenced to appear and their number increased as the test progressed. The test was stopped when the time and effort required for repair of the cracks became prohibitive. In general, the cracks grew slowly and were found in the early stages of growth. The occurrence, distribution and growth of the fatigue cracks are discussed. Author

N67-34488 Materials Research Lab., Inc., Richton Park, Ill.
USE OF CRACK LINE LOADED SPECIMENS FOR MEASURING PLANE STRAIN FRACTURE TOUGHNESS
Sheldon Mostovoy, P. B. Crosley, and E. J. Ripling Jan. 1967 35 p refs

Crack line loading methods for plane strain fracture toughness testing have a number of advantages over remote loading test procedures. These include an ability to measure crack arrest as well as initiation toughness and the possibility of designing a specimen having a linear compliance change with increasing crack length. The latter ability reduces the experimental difficulty of measuring plane strain fracture toughness as well as simplifying the study of sub-critical crack growth typified by fatigue and stress corrosion cracking. Specimen shape requirements for obtaining a linear compliance change as well as the design necessary to minimize the length of crack jumps are discussed. The depth of side groove needed to maintain cracking in the desired plane as a function of specimen anisotropy and shape are also described. Side grooves are shown to minimize slant fractures in running cracks. Flat running fractures are essential if a number of data points are to be obtained on a single specimen without intermediate fatigue crack extension. Author

N67-34547*# Israel Program for Scientific Translations, Ltd., Jerusalem.
SHELLS OF POSITIVE GAUSSIAN CURVATURE UNDER POSTCRITICAL DEFORMATIONS. PART II: LOSS OF STABILITY [STROGO VYPUKLYE OBOLOCHKI PRI ZAKRITICHESKIKH DEFORMATSIYAKH. PART II: POTERYA USTOICHIVOSTI OBOLOCHEK]
A. V. Pogorelov 1967 70 p refs Published for NASA and NSF
(NASA-TT-F-444; TT-67-51376) CFSTI: HC $3.00/MF $0.65
CSCL 20K

The loss of stability of shells of positive Gaussian curvature and shells of rotation under various modes of loading by external pressure is theoretically examined. The problem is also treated for a special isometric transformation of a surface of positive Gaussian curvature. L.S.

N67-34565 Gt. Brit. Ministry of Aviation, London. Aeronautical Research Council.
SYMPOSIUM ON THE USE OF THE DIGITAL COMPUTER IN AIRCRAFT STRUCTURAL DESIGN AND ANALYSIS
G. G. Pope, ed. HMSO, 1967 81 p refs Symp. held in Farnborough, Engl., 15 Apr. 1966 Supersedes RAE-TR-66239; ARC-28703
(ARC-CP-926; RAE-TR-66239; ARC-28703) HMSO: £1 1s 6d

A symposium on the use of the digital computer in aircraft structural design and analysis was held, and was attended by representatives of the aircraft industry, the computer industry, academic institutions, and the Civil Service. This Report reproduces the papers presented at the symposium, and includes an edited version of the discussions that followed the papers. Author

N67-34597# Technische Hogeschool, Eindhoven (Netherlands).
ON VLASOV'S TORSION THEORY FOR THIN-WALLED RECTANGULAR TUBES [OVER DE TORSIETHEORIE VAN VLASOV VOOR DUNWANDIGE RECHTHOEKIGE KOKERS]
Joannes Dominicus Janssen (Ph.D. Thesis) 30 May 1967 158 p refs In DUTCH; ENGLISH summary

The Vlasov theory for thin-walled elastic beam shells with rectangular profiles is investigated for correctness and simplified application in practice. A modification of the theory is derived with the aid of the principle of minimum potential energy, which results in a systematic and clear approach. The specification for infinite beams presented in this thesis simplifies the use of the theory. A load on the cylindrical surface as well as on the end sections of the rectangular tube is analyzed. The thin-walled rectangular tube is considered as a system of thin plates, which reduces the analysis to a combined problem of the two classical theories of thin plates: one with a load in the middle plane, the other with a load perpendicular to it. Results obtained with the exact solution show good agreement with those of the modified Vlasov theory. It is established that by applying the Vlasov approximation, the shear stiffness of the middle plane can be chosen infinite. The stress distribution of concentrated forces applied to a rectangular tube can be ascertained by a periodic block load. Experiments showed that load and profile deviations from the mathematical model greatly affect the results. K.W.

N67-34620 Aeronautical Research Labs., Melbourne (Australia).
A LITERATURE SURVEY ON THE FATIGUE PROPERTIES OF WELDED CHROMIUM–MOLYBDENUM STEEL TUBING
R. Simpson Mar. 1966 49 p refs
(ARL/SM-304)

A literature survey has been carried out on the fatigue properties of unwelded and welded chromium–molybdenum steel tubing of the types employed in aircraft structures. Most of the data examined was for tubing of U.T.S. less than 125,000 p.s.i. Oxyacetylene, atomic hydrogen, electric arc and flash welding processes were considered. It is concluded that: (1) under plane or rotating bending conditions, (a) the fatigue ratio of unwelded tubing steadily decreases with increasing U.T.S. and the maximum fatigue strength (40,000 p.s.i.) corresponds to a U.T.S. of 110,000 p.s.i.; (b) for welded tubing the fatigue ratio is almost constant (approximately 0.2) irrespective of U.T.S. and this infers that the fatigue strength of welded tubing increases with increasing welded U.T.S.; (2) From the fatigue viewpoint there is little to choose between various welding processes; (3) There is a lack of

comprehensive axial load fatigue data for both unwelded and welded tubing; and (4) There is a complete lack of torsional fatigue data. Author

N67-34641# Naval Ship Research and Development Center, Washington, D. C.
STRESSES FROM STRAINS ON WOVEN-ROVING, FIBER-GLASS-REINFORCED PLASTIC
Edwin M. Petrisko Jun. 1967 27 p refs
(Rept.-2426; AD-654164) CFSTI: HC$3.00/MF$0.65

Stress-strain relationships were developed to permit changing strain-gage readings taken on loaded waven-roving, fiber-glass-reinforced plastic. The reinforced-plastic laminate is one in which the mechanical properties vary with direction and cannot be considered constant in the standard strain-gage rosette equations. The equations developed permit a simple solution of stresses for materials whose directional properties do not vary drastically. Author (TAB)

N67-34657*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
BUCKLING OF A PRESSURIZED TOROIDAL RING UNDER UNIFORM EXTERNAL LOADING
George E. Weeks Washington, NASA, Aug. 1967 24 p refs
(NASA-TN-D-4124) CFSTI: HC$3.00/MF$0.65 CSCL 20K

A theoretical investigation of the buckling of a pressurized toroidal ring under a uniformly distributed line load is carried out, with finite shear stiffness, extensional stiffness, and appropriate contributions from the internal pressure taken into account. The equations governing both in-plane and out-of-plane buckling behavior of the ring, with direction of loading included, are derived and solved. The solutions to the buckling equations are presented in terms of five general parameters which are functions of the internal pressure, external load, and ring geometry. The major results of the investigation are: (a) The magnitude of the buckling load is very sensitive to the direction of loading during the buckling deformation and to the ratio of cross-sectional radius to the radius of the ring; (b) the shear stiffness of the ring wall material and internal pressure both contribute to the effective transverse shear stiffness of the ring, which strongly influences the buckling loads. Author

N67-34675# Air Force Systems Command, Wright-Patterson AFB, Ohio. Materials Lab.
SHEAR MODULUS DETERMINATION IN LAMINATED COMPOSITE MATERIALS Technical Report, Jul.–Sep. 1966
James M. Whitney Mar. 1967 20 p refs
(AFML-TR-67-22; AD-653590) CFSTI: HC$3.00/MF$0.65

The report discusses limitations on two widely used methods of measuring shear modulus of fiber reinforced composites. In particular, it is shown that for certain types of fiber lay-ups neither a plate twisting test nor a torsion tube can be used to measure shear modulus directly. Classical theory of laminated plates and cylindrical shells of the Donnell type provides the basis for these conclusions. Circumstances under which these tests can be used to measure shear modulus directly are also discussed. Author (TAB)

N67-34690*# North Carolina State Coll., Raleigh. Dept. of Mechanical and Aerospace Engineering.
ADDITIVE PROPERTY OF MODAL DENSITY FOR A COMPOSITE STRUCTURE Progress Report
F. D. Hart Aug. 1967 20 p refs
(Grant NGR-34-002-035)
(NASA-CR-66453; PR-3) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The additive property of modal density for composite structures is discussed. It is demonstrated analytically that the property is valid for a particular system. The composite structure analyzed consists of two beams joined at right angles to form an L-shaped frame. The receptance approach is used to determine the frequency equation and its asymptotic representation is presented. Graphical presentation of the cumulative number of modes for the composite and its constituents give rise to a verification of the additive property of modal density for a composite structure. Author

N67-34695 Royal Aircraft Establishment, Farnborough (England).
STATIC RESPONSE OF A RAILWAY SIMPLE CATENARY OVERHEAD CONTACT SYSTEM
R. P. Muddle Feb. 1967 13 p
(RAE-TR-67050)

Equations are set up for the equilibrium position of a simple catenary system and for the perturbations caused by a constant disturbing force applied vertically to a given point of the contact wire. A computer program has been written to solve these equations. Author

N67-34751 Lockheed Missiles and Space Co., Palo Alto, Calif.
EXPERIMENTAL INVESTIGATION OF SHELL STABILITY UNDER CREEP CONDITIONS
A. P. Kuznetsov and N. M. Iungerman [1967] 5 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekh. Fiz. (USSR), no. 4, 1965 p 128–131

Results are presented of experimental investigations of the stability of duraluminum thin-walled cylindrical shells under creep conditions for compression and pure bending. Author

N67-34766*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
APPLIED MECHANICS
In its Space Programs Sum. No. 37-45, Vol. IV 30 Jun. 1967 p 57–59 (See N67-34761 20-30)

A concept is defined for a computer program which will be the first step toward the nonlinear analysis of structures. Efficiency is to be attained by using minimum core memory space, shortening the computation time, and reducing round-off errors. These concepts, with additional versatile capabilities for the solution of a large class of linear equilibrium problems, are incorporated into the ELAS program, written in Fortran II to save some of the core storage used for the standard input–output package. The displacement method of analysis, starting from an extremum formulation is used. The coefficient matrix of the equations, in general, is band-limited. Only the coefficients within the band which is being used are stored, thereby saving considerable amounts of storage location, and minimizing the computation time and round-off errors. The special features of ELAS are listed, and it is reported that computer time on the IBM 7094 did not exceed 3 minutes for solving the problems. M.G.J.

N67-34868 Lockheed Missiles and Space Co., Palo Alto, Calif.
ON CONDITIONS OF QUASI-BRITTLE FRACTURE [OB USLOVIIAKH KVAZIKHRUPKOGO RAZRUSHENIIA]
L. V. Ershov and D. D. Ivlev [1967] 11 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (Moscow), v. 31, no. 3, 1967 p 537–542

A theoretical analysis of the fracture mechanics of deformable solids is presented. The theory for crack propagation in solids may also be considered as a theory for the fracture of elastic bodies. A Griffith model of an elastic body with slits is considered. Changes in the surface energy of the body, are mathematically described. Another analogous example treated is the use of the Mohr fracture theory to determine the strength of elastic bodies

from materials with different physical mechanisms for the strength properties. When the Mohr theory is used, the condition of the ultimate state determined from a system of macro-tests takes on importance. Also treated are the condition for propagation of finite cavities in elastic bodies, and the development of a circular cavity of given radius in an elastic space compressed at infinity by a uniform pressure. L.S.

N67-34869 Lockheed Missiles and Space Co., Palo Alto, Calif.
ON ERROR ESTIMATES FOR APPROXIMATIONS OF NATURAL VIBRATION FREQUENCIES OF A FREE BEAM WITH VARIABLE PARAMETERS
K. I. Kukhta and V. P. Kravchenko [1967] 2 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 6, 1967 p 800–802

On the basis of integral equation theory it was shown that a given inequality expression is satisfied for the exact and approximate frequencies of the transverse vibrations of a free beam of given length at a number of whose points where loads are concentrated. The norm of an operator needed for the expression was estimated in order to estimate the errors in the found natural vibration frequencies of the beam. L.S.

N67-34870 Lockheed Missiles and Space Co., Palo Alto, Calif.
SHELL STABILITY UNDER CREEP CONDITIONS
E. P. Grigoliuk and Iu. V. Lipovtsev [1967] 7 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekh. Fiz. (USSR), no. 4, 1965 p 111–116

Equations for the physical relationship between the stress and displacement components of a shell buckling under creep conditions, are presented. Expressions for the stress resultants and moments are given. Stability equations are also given for a shallow shell of general form, and for a closed cylindrical shell under axial compression. L.S.

N67-34909# Royal Aircraft Establishment, Farnborough (England).
THE RESIDUAL STATIC STRENGTH OF A BOLTED JOINT CRACKED IN FATIGUE
W. T. Kirkby and G. R. Eynon Apr. 1966 21 p refs
(RAE-TR-66111) CFSTI: HC $3.00/MF $0.65

An investigation was made on a multibolt joint to establish the relationship between fatigue damage and residual static strength. The joints consisted of a bar made from B.S.L.65 aluminium alloy bolted between steel side plates. Static tensile tests were made on joints which had previously been used for a fatigue investigation in which they had been subjected to varying histories of fatigue loadings but had not been completely broken. The static failures always occurred to the aluminium alloy bar, and the fracture surfaces were subsequently examined to establish the percentage of the cross-section that had been cracked by the previous history of fatigue loading. It was found that joints which showed no evidence of such cracking, apparent to the naked eye when examining the fracture surfaces, retained their original static strength. Relationships between the percentage of the cross-sectional area cracked and the residual static strength were established. Author

N67-34910*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
HANDBOOK OF THERMAL DESIGN DATA FOR MULTILAYER INSULATION SYSTEMS, VOLUME II Final Report
R. M. Coston 25 Jun. 1967 180 p refs
(Contract NASS-20353)
(NASA-CR-87485; LMSC-A847882, Vol. II) CSCL 20K

Gases, metals, fiberglass laminates, and multilayer insulations are considered in a handbook that details high performance thermal design criteria for multilayer insulation systems. Thermal and physical properties of such insulations are provided for application to mathematical thermal models of cryogenic propellant tankage. Details are included for the substrates, materials, composites, attachment methods, and experimental methods related to multilayer insulations; and the effective thermal conductivity of NRC-2 shingle insulation is calculated. M.W.R.

N67-34939# Picatinny Arsenal, Dover, N. J. Ammunition Engineering Directorate.
X-RAY STRESS ANALYSIS OF THE BAUSCHINGER EFFECT IN METALS
Donald L. Bagnoli and Jacob J. Klappholz Apr. 1967 46 p refs
(PA-TR-3564; AD-654142) CFSTI: HC $3.00/MF $0.65

As a result of tensile tests performed on fired 175mm shell bodies, it was observed that the yield point was lower after loading the shell in set-back. A sizeable difference in yield strength was measured between as-fired and unfired shells with little difference in ultimate tensile strength. One possible cause of this phenomenon is the Bauschinger Effect. The Bauschinger Effect states that a specimen which is plastically strained in one direction and along one axis has a greater yield strength for that direction, but reduced loading strength in the opposite direction. To prove the magnitude to which this material would undergo a reduction in yield, X-ray diffraction measurements were made of beams cut from specimen shell bodies. X-ray stress measurements were made while the beam was maintained under different loads. A computer program was developed to calculate residual stress. Author (TAB)

N67-34963# Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
AN EXPERIMENTAL STUDY OF THE HYDROELASTIC INSTABILITY OF SUPERCAVITATING HYDROFOILS
C. S. Song and John Almo Feb. 1967 55 p refs Prepared for David Taylor Model Basin
(Contract Nonr-710(66))
(Rept.-89; AD-654145) CFSTI: HC $3.00/MF $0.65

Some experimental findings concerning the flutter characteristics of two-dimensional supercavitating flat-plate hydrofoils are reported. The experiment was carried out in a free-jet water tunnel using wedge-shaped hydrofoils (practically rigid) elastically supported to permit two degree of freedom motions in translational and rotational modes. Critical flutter speed, flutter frequency, flutter amplitude ratio, and damping factor were measured for various elastic and flow conditions. The measured stability boundary curves agree, qualitatively, with an existing linear theory. The effect of leading-edge condition, free surface, ventilation, cavity length, and friction were also explored. The magnitude and the complexity of the leading-edge effect on the critical flutter speed is particularly noteworthy. A cavity pinch-off phenomenon was revealed. Also revealed are the occurrence of a rolling mode of flutter and cavity pulsation which may coexist with the two degree of freedom flutter under certain circumstances. Author (TAB)

N67-34973 Technische Hochschule Aachen (West Germany). Inst. fuer Strahlantriebe und Turboarbeitsmaschinen.
STRESS ANALYSES ON RADIAL-FLOW IMPELLER WHEELS [FESTIGKEITSUNTERSUCHUNGEN AN RADIAL DURCHSTROEMTEN LAUFRAEDERN]
Wilhelm Soetebeer [1966] 13 p In GERMAN Presented at the DGRR/WGLR Ann. Conf., Bad Godesberg, W. Germany, Oct. 1966

Stress analyses of centrifugal flow impeller wheels are conducted to find a suitable method of calculation that would take into account with sufficient accuracy their complicated geometric designs. The theoretical calculations therefore differ from the conventional methods of calculation used for symmetrical discs.

Theoretical calculation, however, still necessitates simplifying assumptions, so that calculations must be supplemented by experiments in order to check the accuracy of calculation. For such experimental examinations, a test stand was developed to carry out quasi-static measurements on rotating models with the aid of strain gauges. The measuring system and the measuring device are explained, and it is shown that the magnitude of measuring errors can be kept within very small limits by the selected system of transmitting the test data. Author

N67-34991# Sandia Corp., Albuquerque, N. Mex.
APPLICATION OF DISLOCATION DYNAMICS TO IMPACT INDUCED DEFORMATION UNDER UNIAXIAL STRAIN
B. M. Butcher and D. E. Munson Apr. 1967 29 p refs Presented at the Colloq. on Dislocation Dyn. Conf., Seattle
(Contract AT(29-1)-789)
(SC-DC-67-1402; CONF-670513-1) CFSTI: HC $3.00/MF $0.65

The extent to which several mathematical representations of dislocation motion can be used to describe elastic wave attenuation in 4340 steel was investigated. It was found that the Gilman relation described the experimental data quite well, although the values of the parameters were strongly influenced by the choice of the input stress condition. A linear velocity relationship also described the experimental data adequately, but not as precisely as the Gilman function. The thermal activation function showed marked discrepancies. A simple analysis of the plastic wave in 4340 steel showed that the plastic strain at a given position in the material developed at a nearly constant value of the maximum shear stress. The magnitude of this stress was about the same as the amplitude of the elastic wave at that position. Dislocation velocities appear to be small compared to the shear wave velocity, so that the large plastic strain rates calculated from the experimental records indicated considerable dislocation multiplication. A linear relation between plastic strain rate and plastic strain at constant stress was observed; but the data are not over a sufficient range to test the hypothesis that the dislocation density relation can be taken as a function of strain alone. Parameters for the elastic wave attenuation in 1060 aluminum were computed using the Gilman function. This information and a dislocation multiplication model based only on plastic strain were used to make a parametric study of the plastic wave profile. Qualitative agreement was obtained for certain aspects of the wave. The model did not account for material deformation close to the impact plane; the calculations predicted much greater relaxation behind the elastic precursor than was observed. Author (NSA)

N67-35001*# McGill Univ., Montreal (Quebec). Space Research Inst.
REVIEW OF METEOROID-BUMPER INTERACTION STUDIES AT MC GILL UNIVERSITY Final Report
W. H. Friend, C. L. Murphy, and I. Shanfield Aug. 1966 196 p refs
(Contract NAS3-4190)
(NASA-CR-54857; SRI-R-15) CSCL 20K

Two theoretical models for the analysis of the impact of a cylindrical pellet moving in the direction of its axis and impacting normally against a thin bumper sheet have been studied. An approximate model which draws heavily on experimental data for the impact cloud expansion coefficient has been developed. With this model, the downstream cloud boundary and centerline pressure distribution can be predicted for the impact of similar materials at impact velocities in the meteoroid regime and in the range of the laboratory experiment (6–11 km/sec). An exact model in which computer solutions based on the method of characteristics and finite difference schemes are used to study the initial impact and subsequent expansion processes is under active development. Information concerning the shocked states in the projectile and target for different material combinations has been obtained. A hypervelocity impact facility has been developed in which projectile velocities of 9.6 km/sec have been achieved with one-half inch (1.27 cm) diameter projectiles weighing 1.5 grams and 10.5 km/sec with projectiles weighing approximately 1.1 grams. Instrumentation has been developed to measure the projectile velocity within one foot of the gun muzzle to achieve maximum positional and orientation accuracy. Author

N67-35003 Zentralinstitut fuer Forschung und Entwicklung, Essen (West Germany).
DEVELOPMENT OF MULTILAYER LARGE STEEL VESSELS [ENTWICKLUNG GROSSER STAHLBEHAELTER IN MEHRLAGENBAUWEISE] Annual Report, Jul. 1965–Jul. 1966
Fried. Krupp Brussels, Euratom, May 1967 53 p refs In GERMAN; ENGLISH summary
(Contract EURATOM-037-64-7 TEED)
(EUR-3460.d)

Material studies were conducted to develop multilayer large steel vessels. Normalized, hardened, and heat-resistant steels were examined for chemical composition; test methods; strength and toughness properties at room temperature and higher temperatures; aging; tensile fatigue, and Wöhler curves. Welding studies consisted of heat-affected zone of base metal, influence of heating, residence and cooling time, and maximum temperature. Also considered were hardening or softening, bending angle and toughness in transition zone, filler materials, preheating temperatures, static and dynamic stresses on three piece corner seams, stress orientation, seam form, and electrode material. Model studies consisted of photoelastic models of three-piece corner seams, various stresses, thermal conductivity of multilayer wall, surface roughness of plates, contact pressure, and heat transfer coefficient. Calculation and design studies involved devices for the construction of singly or doubly curved sections, stresses at transition between cylinder and head, and equations for shear-free strengthening. Author

N67-35017*# Boeing Co., Seattle, Wash. Aerospace Group.
EXTENDED LOADING OF CYROGENIC TANKS Final Report, Jun. 1965–Dec. 1966
C. F. Tiffany, P. M. Lorenz, and R. C. Shah Dec. 1966 202 p refs
(Contract NAS3-6290)
(NASA-CR-72252) CSCL 20K

Plane-strain flaw growth characteristics under sustained loading and combined cyclic-sustained loading conditions as well as static fracture toughness values were obtained for 2219-T87 aluminum and 5A1-2.5 Sn (ELI) annealed titanium. Investigations were conducted at room temperature, −320°F and −423°F in ambient air, liquid nitrogen and liquid hydrogen environments, respectively. The experimental approach was based on linear-elastic fracture mechanics. Results from surface-flawed uniaxial specimens and cylindrical tanks were compared. It was concluded that the effects of cyclic and sustained loading may be combined and used in the design of cryogenic pressure vessels. Author

N67-35036 Lockheed Missiles and Space Co., Palo Alto, Calif.
INFLUENCE OF THE SCALE FACTOR IN HIGH-SPEED COLLISION OF SOLID PARTICLES WITH AN OBSTACLE
G. V. Stepanov [1966] 4 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 2, no. 12, 1966 p 82–85

Results of experiments on the collision of different diameter spheres (from 3–20 mm) with bulk targets simulating a half-space are presented. The target and spheres were lead. The volume of the crater in the 500–2000 m/s velocity range is proportional to the kinetic energy of the impacting sphere, and the depth and diameter, to the cube root of the energy. On the basis of the experiments, the deduction is made that the scale effect exerts

negligible influence in the mentioned range of variation of the particle velocity and size. Author

N67-35098# Sandia Corp., Albuquerque, N. Mex.
RESPONSE OF AN ELASTIC CYLINDRICAL SHELL TO A TRANSVERSE, ACOUSTIC PULSE
Michael J. Forrestal Apr. 1967 24 p refs
(Contract AT(29-1)-789)
(SC-TM-67-235) CFSTI: HC $3.00/MF $0.65

A long cylindrical shell is subjected to a plane acoustic wave whose front is parallel to the axis of the shell. Response formulae for the dilatational and first flexural modes for a step pressure pulse are developed. These formulae are in terms of elementary functions and can easily be used as influence coefficients to determine, by means of Duhamel integrals, the response produced by an arbitrary pressure pulse. Author (NSA)

N67-35112# Sandia Corp., Albuquerque, N. Mex.
SWAP-7: A STRESS-WAVE ANALYZING PROGRAM
L. M. Barker Apr. 1967 126 p refs
(Contract AT(29-1)-789)
(SC-RR-67-143) CFSTI: HC $3.00/MF $0.65

The SWAP-7 computer program for solving stress-wave problems in one-dimensional strain is described in detail. Typical computer run times are 1 to 5 minutes per problem. The program handles both hydrostatic and elastic-plastic materials, and can incorporate such effects as work hardening, changes in elastic constants and yield strength with pressure and internal energy, and spall at a given tensile stress. The program output provides the stress, strain, material velocity, and internal energy at all positions and times covered in the problem. Author (NSA)

N67-35152# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
AN APPLICATION OF MIYATA'S SYNTHESIS PROCEDURE TO LINEAR MECHANICAL VIBRATION SYSTEMS
J. A. Joyce *In its* 7th Student Symp. on Eng. Mech. 3 Jun. 1967 23 p refs (See N67-35148 20-17)

A subclass of driving-point, positive real functions are systematically reduced to a simple network of vibratory elements by using the synthesis technique introduced by Miyata. The general Miyata procedure and the Miyata half-n procedure are outlined and two illustrative examples are worked. Author

N67-35161 Lockheed Missiles and Space Co., Palo Alto, Calif.
EXPERIENCE WITH THE UTILIZATION OF HIGH-SPEED MOVING PICTURES TO INVESTIGATE THE HIGH-SPEED DEFORMATION PROCESS
A. I. Lopatin, V. G. Kas'ian, and V. V. Savrasov [1966] 4 p refs Transl. into ENGLISH from Samoletostr. i Tekhn. Vozdushn. Flota (USSR), no. 7, 1966 p 85–88

High speed moving pictures were used to record the motion kinematics of a billet during high speed deformation. By fixing the position of some point of the billet on the moving picture film, the time dependence of the displacement of a billet element was determined. By graphical differentiation of the dependence h = f(t), curves were obtained which characterize the time change in velocity and acceleration of the motion of the billet elements. A diagram of the apparatus used for the study, and a circuit diagram of the synchronizing unit, are depicted. L.S.

N67-35202 Tasmania Univ., Hobart (Australia).
DEVELOPMENT AND APPLICATION OF A MOIRE FRINGE TECHNIQUE TO THE ANALYSIS OF A STRUCTURAL KNEE
C. J. Jenkins (M.S. Thesis) Dec. 1965 89 p refs

The technique of making inexpensive diffraction gratings of a quality suitable for moire fringe strain analysis is described together with a method of viewing the gratings for best results. The use of a reference grid avoids the need for resolving fine lines. A secondary moire pattern obtained by interfering two primary patterns from different loads is used to measure displacements and eliminates imperfections from the gratings. The strain and displacement patterns in knee joints tested by this method are described, and some analytical methods of solving for stress and strain distributions are investigated. Author

N67-35210 Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
ON THE BUCKLING OF TRUNCATED CONICAL SHELLS UNDER UNIFORM STATIC PRESSURE
A. Kornecki [1966] 27 p refs
(TAE-64)

An asymptotic method is derived for simplifying Donnel equations governing the problem. The case of a shell simply supported along both ends is solved numerically. Author

N67-35217 Douglas Aircraft Co., Inc., Newport Beach, Calif. Acoustics and Dynamics Environmental Labs.
MECHANICAL IMPEDANCE/ADMITTANCE TESTING OF LARGE AEROSPACE STRUCTURES
F. G. McKinney [1967] 52 p refs Presented to the Soc. of Scientists and Engr., Los Angeles, 17 Feb. 1967
(Douglas Paper-4046)

The results of mechanical impedance/admittance tests were performed on a Saturn S-IV Thrust Structure (Boattail), using recently developed instrumentation and analysis techniques. Validity of the tests was verified by performing both an impedance/admittance test and a vibration test on a dummy aluminum beam and comparing the correlation between the respective sets of data obtained. The information presented herein is intended to serve the following purposes: (1) To aid in predicting equipment responses in new installations, (2) To provide a more precise definition of isolator requirements and effectiveness, and (3) To provide guidelines for the use of mechanical impedance/admittance tests as a reliable and practical method of dynamic testing of unloaded and loaded structures. Author

N67-35221# General Dynamics/Convair, San Diego, Calif.
DESIGN AND ANALYTICAL STUDY OF COMPOSITE STRUCTURES
J. W. Lyman, J. D. Forest, and F. Porter Dec. 1966 109 p refs
(GDC-ERR-AN-1077)

Composite data, research and development investigations, and application of metal matrix composite materials to aerospace structures are reported. A theoretical glass–boron–epoxy composite is used for the design of a manned reentry vehicle; and weight comparisons are made. Composite material data appearing in the 1966 literature are summarized to permit comparison of structures efficiency for various loading conditions. Metal matrix composites, such as A1-B are reported to exhibit improved shear properties over resin matrix composites; and this metal matrix allows the introduction of concentrated loads without orienting fibers in secondary load conditions. A structure weight savings of 38% is reported for a hypothetical glass–boron–epoxy composite fluted-core sandwich structure; and a weight reduction of 39.5% is indicated by using a composite instead of stainless steel for the booster skins of the Saturn launch vehicle-3X/Agena. The A1-B composite

indicated a 53% weight savings for truss tubing in space erectable antennas and 52% in a plate stringer configuration of the PRIME adapter. M.W.R.

N67-35262*# Illinois Univ., Urbana. Engineering Experiment Station.
TRANSIENT THERMAL BEHAVIOR OF SIMPLE STRUCTURES IN A SIMULATED SPACE ENVIRONMENT BY MODEL TESTING
B. T. Chao, J. S. De Paiva, Netto, and M. N. Huang Jul. 1967 84 p refs
(Grant NGR-14-005-048)
(NASA-CR-87447; ME-TR-NGR-048) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Transient modeling criteria and modeling design procedure are presented in terms of unmanned spacecraft for which the modes of heat transfer are dominated by radiation and conduction. Geometric and time scale of the fabricated model configuration for determining thermal behavior in a simulated space environment are presented; and the space simulation chamber, power supply and power measurement, the data recording system, and the test procedure are described. Both steady state temperature distributions and transient results from these experiments are included; and appendixes detail the following: (1) thermal conductivity measurement, (2) thermal conductivity of electroplated copper, (3) heat capacity data, and (4) thermocouple calibration and installation procedure. M.W.R.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N67-34040# Bureau of Mines, Berkeley, Calif.
THERMODYNAMIC PROPERTIES OF THREE LITHIUM–ALUMINUM SILICATES
L. B. Pankratz and W. W. Weller Aug. 1967 13 p refs
(BM-RI-7001)

Measured were heat capacities of alpha and beta spodumene ($LiAlSi_2O_6$) and of beta eucryptite ($LiAlSiO_4$) over the temperature range 51° to 298°K. The entropies at 298°K were found to be 30.9±0.2 cal/deg mole for alpha spodumene, 36.9±0.3 cal/deg mole for beta spodumene, and 24.8±0.2 cal/deg mole for beta eucryptite. High-temperature heat content measurements above 298°K were conducted for the same compounds. Measurements were made to 1,150°K for alpha spodumene, 1,600°K for beta spodumene, and 1,470°K for beta eucryptite. Tables of heats and free energies of formation are given from the elements and from the constituent oxides. Author

N67-34071# Bureau of Mines, Pittsburgh, Pa.
A NUMERICAL METHOD FOR DETERMINING HEAT-TRANSFER CHARACTERISTICS FOR A DILUTE GAS-SOLIDS MIXTURE IN AN EXTERNALLY HEATED TUBE
Michael J. Lempel Jul. 1967 20 p refs
(BM-IC-8343) CFSTI: HC $3.00/MF $0.65

A theoretical study of the heat transfer characteristics of a dilute gas-solid mixture in an externally heated tube is reported. Detailed equations are developed describing the system, and a numerical method is presented to solve the equations using a digital computer. The methods are applied to a system containing fine coal particles entrained in hydrogen, flowing through a hot tube. Heat transfer coefficients and several other physical constants are also evaluated. Author

N67-34078# Aerojet-General Nucleonics, San Ramon, Calif. Nuclear Products and Services Group.
ALKALI METALS EVALUATION PROGRAM. THERMODYNAMIC AND TRANSPORT PROPERTIES OF CESIUM AND RUBIDIUM PVT PROPERTIES
P. Y. Achener, A. R. Miller, D. Fisher, and M. Olbrantz Feb. 1967 104 p refs
(Contract AT(04-3)-368)
(AGN-8192, Vol. I) CFSTI: HC $3.00/MF $0.65

The pressure–volume–temperature properties of superheated cesium vapor were determined at temperatures from 1067.1 to 1489.3°K at pressures from 2.178 to 12.74 atm, and of superheated rubidium vapor at temperatures from 1067.4 atm, to 1493.7°K at pressures from 2.075 to 14.80 atm. The experimental method involved the use of a constant volume capsule fitted with a null-type diaphragm for the measurement of pressure. The experimental data was used to develop virial equations of state explicit in pressure, from which the desired properties of enthalpy, entropy, specific heat, and compressibility were calculated. Author (NSA)

N67-34084# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
TRANSIENT TEMPERATURE DISTRIBUTION IN A SOLID SPHERE DUE TO AERODYNAMIC HEATING
Robert N. Coppolino and S. V. Nardo Jun. 1967 34 p refs
(Contract Nonr-839(23))
(PIBAL-934; AD-653873) CFSTI: HC $3.00/MF $0.65

A solid or thick-walled spherical body of low-conductivity material is analyzed for the transient temperature distribution immediately after the application of axisymmetric aerodynamic heating and before the onset of sublimation at the heated surface. The problem of temperature determination is complicated by the fact that the heat flux across the heated surface in the case of aerodynamic heating is a function of the unknown surface temperature. Moreover, the heat flux, even if already known, is a non-separable function of time and meridional location. The heat conduction equation is therefore solved approximately by the use of an extended Goodman heat balance integral technique which is completely analogous to the Karman-Pohlhausen integral method for boundary layer analysis. The technique reduces a second order partial differential equation to a first-order non-linear differential equation which is readily integrated. The approximate solution to the reduced problem of heat conduction with point-symmetric aerodynamic heating is compared with a known exact solution and it is found that there is excellent agreement between the two solutions. Author (TAB)

N67-34112# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
CALCULATIONS OF THE THERMAL SCATTERING LAW FOR SOLIDS AND LIQUIDS
R. G. Jarvis Jun. 1967 14 p refs Presented at the IAEA Symp. on Neutron Thermalization and Reactor Spectra, Ann Arbor, Mich., 17–21 Jul. 1967
(AECL-2705; SM-96/23) CFSTI: HC $3.00/MF $0.65

A method has been developed, based on the incoherent approximation, to describe scattering in solids and liquids. It deals

with molecules which are made up of one or more types of scatterer, such as UO_2 and D_2O. For each scatterer there is a scattering law $S(\alpha,\beta) = 1/2\pi \int_{-\infty}^{\infty} \exp(-\alpha w(t)) \exp(i\beta t)\, dt$ in Egelstaff's notation. The width function w(t) corresponds to a 'generalized frequency distribution' $\rho(\beta)$ which, in its most complicated form, has five components. The first and second describe sharp peaks (such as the two main vibration levels in D_2O), the third and fourth represent broader peaks (such as the combined effects of minor vibration levels and the rotations and translations), the fifth is for diffusion and is omitted for solids. The integral for S is expanded over the vibration terms and then evaluated by a combination of numerical methods and saddle-point integrations. Finally, the S's for the scatterers are combined to give an S for the molecule. Author

N67-34136# Technische Hochschule München (West Germany). Institut fuer Technische Thermodynamik.

PRESSURE DROP AND HEAT TRANSFER IN LAMINAR AND TURBULENT TUBE FLOW OF MERCURY [DRUCKABFALL UND WAERMEUEBERGANG BEI DER LAMINAREN UND TURBULENTEN ROHRSTROEMUNG VON QUECKSILBER]

H. Tratz Bad Godesburg, W. Germany, Bundesmin. fuer Wiss. Forschung, Jan. 1967 94 p refs In GERMAN; ENGLISH summary
(BMWF-FBK-67-05)

Abnormalities in the hydrodynamic and thermal behavior of liquid metals prompted this work. For the investigation of pressure drop and heat transfer an apparatus was developed which allowed measurements without any conceivable perturbations. The results of these measurements are in such good agreement with theoretical predictions that it can be stated that hydrodynamic and thermal behavior of pure mercury along pure steel walls is that of a normal liquid. The influence of argon dissolved in the mercury or adsorbed at the tube wall is small. These definite principles are obtained for the calculation of liquid metal cycles which are used in nuclear and astronautic applications. Author (NSA)

N67-34161# M. A. N. Werk, Augsburg (West Germany).

STUDY ON BURNOUT HEAT FLUX IN BOILING WATER Quarterly Report, 1 Jan.–28 Feb. 1966

F. Mayinger, O. Schad, and E. Weiss Mar. 1966 32 p refs
(Contract EURATOM-057-61-RDD)
(EURAEC-1524; QR-18; Rept.-09.02.11; EUR-2817) CFSTI: HC $3.00/MF $0.65

A number of measurements were performed which showed that orificing at the inlet of a highly stressed heating channel is a reliable and effective way of preventing pulsating burnout. Since increased orificing requires additional pump power, every effort is being made to keep this pressure drop, which is produced for reasons of pulsation safety, as low as possible. Studies were therefore previously carried out on this minimum orificing for different thermodynamic and hydrodynamic design conditions. These measurements were taken on internal-flow round pipes 7 mm in diameter at mass flow rates of 230 to 400 g/cm^2/sec and pressures of 70 and 100 atm. The orificing is carried out by reducing the flow section and thus has a double influence on the pulsations. On the one hand, the oscillations are damped as a result of the increased friction, and on the other, there is a partial reflection of the pressure waves at the orificing point. Studies were performed to determine what quantitative effect low mass flow rates of 100 to 250 g/cm^2/sec have on minimum orificing and to what extent it is affected by the diameter of the test channel. Further measurements were therefore performed in the pulsating burnout range at the above pressures on round internal-flow pipes 11 and 15 mm in diameter and the reduction in the orificing effect for decreasing mass flow rate and increasing flow section determined. With these geometric and hydrodynamic parameters it is much better to ensure that there are no spaces filled with compressible substances immediately upstream of the heating channel, since they have a far greater influence on pulsating burnout than the orificing. In the hydrodynamically stable burnout range measurements were carried out with a sinusoidal heat flux distribution over the length of a round internal-flow pipe (L/D ratio 80). The maximum heat flux in the middle of this pipe was precisely double the minimum value at the two ends. The measurements showed the same total heat input is possible with this heat flux distribution as with uniform heat flux, which in comparison with this latter indicates that the heat flux density at the peak of the sinusoidal distribution is greater by a factor of 1.2 Author (NSA)

N67-34207# General Electric Co., Schenectady, N. Y. Research and Development Center.

CONFIGURATIONAL ENTHALPY OF POLYSTYRENE

R. M. Joshi, B. J. Zwolinski (Tex. A&M Univ.), J. M. O'Reilly, and F. E. Karasz Nov. 1966 8 p refs
(Rept.-66-C-391)

Recent precision measurements of the heats of combustion of atactic and isotactic polystyrene permit an unequivocal calculation of the configurational enthalpy of this polymer. The result is not in agreement with calculations based on analysis of model-compound solution NMR spectra, and possible reasons for this are discussed. The method has potentially important applications in studying molecular interactions in stereoregular polymers. Author

N67-34354# California Univ., Berkeley. Lawrence Radiation Lab.

ON THE MECHANISM OF ELECTROLYTIC GAS EVOLUTION

Huk Yuk Cheh (Ph.D. Thesis) Feb. 1967 111 p refs
(Contract W-7405-ENG-48)
(UCRL-17324) CFSTI: HC $3.00/MF $0.65

A review on the various steps involved in the formation of a gas phase at an electrode-solution interface and on the mass transfer aspects associated with the overall process is presented. The analogies between electrolytic gas evolution and nucleate boiling are also discussed. Theoretical calculations on the dynamics of asymptotic bubble growth in an initially nonuniform concentration or temperature field are performed. For the case of electrolytic gas evolution, a significant simplification is achieved by noting that the Jakob number for mass transfer is usually small so that the convective transport can be neglected in comparison with the diffusive transport. Numerical solutions are obtained for the growth rate of a hemispherical bubble on an electrode surface with linear and exponential initial concentration fields of the electrolytically generated gas and also for the cases involving initial concentration fields resulting from the constant potential and constant current experiments. For the case of nucleate boiling, the parametric solution of Skinner and Bankoff using the thin thermal boundary layer approximation associated with the large Jakob number for heat transfer is applied to obtain numerical solutions for the cases of constant potential and constant current. Theoretical calculation for fluid flow and for mass transfer to rising bubbles or drops at both large Re and large Pe numbers are performed using the boundary layer approach of Levich. Satisfactory agreement is obtained when comparison is made to available experimental data. Possible extensions for future investigations are outlined. Author (NSA)

N67-34355# Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.

ON THE DISTRIBUTION OF MOMENTUM, HEAT AND MATTER IN AXISYMMETRICAL JET DIFFUSION FLAMES. PART I: THEORETICAL STUDY

A. Chervinsky and Y. M. Timnat Mar. 1967 31 p refs
(TAE-62)

The axisymmetrical boundary layer equations of motion, energy and mass are considered for the case of Lewis number

unity and solutions are given in the von Mises plane. Approximating the flame front as a surface and assuming a one step stoichiometric chemical reaction the shape of the flame front in Propane-Air diffusion flames is calculated. The two cases of laminar and turbulent flames are considered in a similar manner, replacing the molecular viscosity appearing in one case by the turbulent eddy viscosity in the other. The transformation of the theoretical results to the physical plane is discussed and expressions suitable for comparison with experimental results are presented. Author

N67-34404# Technische Hochschule München (West Germany).
PRESENTATION AND TESTING OF THE MATHEMATICAL MODEL FOR THE OPERATING DATA OF A STEAM-HEATED BOILER TUBE CLUSTER HEAT EXCHANGER [AUFSTELLUNG UND PRUEFUNG DES MATHEMATISCHEN MODELLS FUER DIE BETRIEBSDATEN EINES DAMPFBEHEIZTEN ROHRBUENDELWAERMEUEBERTRAGERS]
Horst Zimmermann (Ph.D. Thesis) [1966] 146 p refs In GERMAN CFSTI: HC $3.00/MF $0.65

The model represents a cluster of smooth, straight tubes which in the simplest case is operated as a preheater for the material flowing in the tubes. The heating medium surrounding the tubes is saturated steam. No chemical reactions or phase changes are assumed to occur. The initial task is to determine all factors affecting heat transfer and pressure losses. Analyzed are temperature increases and pressure losses of the water flow in the heat exchanger, distribution of the inflow to the tubes, heating of the water in the single tube, heating which takes place at the bottom of the tube, and the breakdown of the pressure loss within the heat exchanger. Separately determined are the effects of inflow and outflow port configurations on flow distribution within the tube cluster. Results are compared with those obtained in experiments with a single-tube heat exchanger. The transition between laminar and turbulent flow is included. Reproducibility of the method was verified through control measurements after 10 weeks.
Transl. by K.W.

N67-34492# Purdue Univ., Lafayette, Ind. Thermophysical Properties Research Center.
THERMAL CONDUCTIVITY OF SELECTED MATERIALS
R. W. Powell, C. Y. Ho, and P. E. Liley Gaithersburg, Md., NBS, 25 Nov. 1966 175 p refs
(NSRDS-NBS-8) GPO: $1.00

Available thermal conductivity data were evaluated and compiled on eleven metals, nine nonmetallic solids, and seven fluids for both liquid and gaseous states, and on two others for the liquid state only. Materials studied were selected primarily for their potential as reference standards or because of their technical importance. Metals studied were: solid and liquid aluminum, copper, gold, pure and Armco iron, manganin, liquid mercury, platinum, platinum alloyed with 40% rhodium, silver, and tungsten. Nonmetallic solids included: aluminum oxide, beryllium oxide, glass, diamond, magnesium oxide, glass ceramic, quartz, thorium dioxide, and titanium dioxide. Argon, carbon tetrachloride, diphenyl, helium, nitrogen, toluene, and water vapor were among the gaseous substances evaluated. Extensive thermal conductivity graphs and tables, departure plots, and specimen specification tables are given.
E.C.

N67-34527# RAND Corp., Santa Monica, Calif.
THE THERMODYNAMICS OF THE MAGNESIUM SILICATE/MAGNESIUM-SILICON-OXYGEN VAPOR SYSTEM
F. J. Krieger Apr. 1967 51 p refs
(Contract F-44620-67-C-0045; Proj. RAND)
(RM-5337-PR; AD-653925) CFSTI: HC $3.00/MF $0.65

The thermodynamic properties of magnesium silicate were investigated over a range of temperatures up to 6000K and pressures up to 1000 atmospheres. Three sets of equilibrium composition equations were used--one representing a pure gas phase, the second a heterogeneous system of gas and condensed magnesia, and the third a heterogeneous system of gas and condensed magnesia and silica. Tabulated summaries give computed values of volume, molecular weight, moles of gas, moles of solid or liquid magnesia and silica, density, enthalpy, energy, and entropy for magnesium silicate at various temperatures and pressures. A conventional Mollier diagram is included in which specific enthalpy is plotted against specific entropy, with cross plots of temperature, pressure, and molecular weight or moles of condensed magnesia and silica. The variation of sublimation temperature with pressure is also shown for magnesia and silica both alone and in the presence of each other. Author (TAB)

N67-34539* Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
BUBBLE FORMATION AND GROWTH—STUDY OF THE BOUNDARY CONDITIONS AT A LIQUID-VAPOR INTERFACE THROUGH IRREVERSIBLE THERMODYNAMICS Final Report, Feb. 1966–Feb. 1967
Robert R. Adt, Jr., Walter J. Bomhorst, and George N. Hatsopoulos Feb. 1967 55 p refs
(Contract NAS8-20013)
(NASA-CR-87478) CFSTI: $3.00 CSCL 20M

An experimental and theoretical investigation of the transport coefficients which appear in previously obtained linear irreversible-thermodynamic rate equations of a phase change is presented. An experiment which involves the steady-state evaporation of mercury was performed to measure the principal transport coefficient appearing in the mass-rate equation and the coupling transport coefficient appearing in both the mass-rate equation and the energy-rate equation. The principal transport coefficient σ, usually termed the condensation or evaporation coefficient is found to be approximately 0.9 which is higher than that measured previously in condensation experiments. The experimental value of the coupling coefficient K does not agree with the value predicted from Schrage's kinetic analysis of the phase change. Author

N67-34546*# Michigan Univ., Ann Arbor. Gas Dynamics Labs.
SOLUTION OF THE BLASIUS BOUNDARY LAYER EQUATION BEHIND A SHOCK WITH VAPORIZATION AND COMBUSTION AT THE WALL
Kenneth W. Ragland Jul. 1967 61 p refs
(Contract NASr-54(07))
(NASA-CR-72235) CFSTI: HC $3.00/MF $0.65 CSCL 21B

Solutions of the Blasius boundary layer equation which account for vaporization and combustion on a flat wall behind a normal shock are presented. The solutions, which were obtained on an analog computer, cover a wide range of shock Mach numbers and wall material-gas combinations. Coefficients of mass transfer, drag and heat transfer to the wall are tabulated. Author

N67-34564# National Aerospace Lab., Tokyo (Japan).
THERMAL INSULATION OF METAL FOIL FOR THE CASE OF CIRCULAR PIPE FLOW
Kenji Inouye 1967 13 p refs In JAPANESE; ENGLISH summary
(NAL-TR-129) CFSTI: HC $3.00/MF $0.65

An analysis is made of the transient heat transfer between a circular pipe having multi-layered metal foil inside for thermal insulation and a fluid moving through the pipe, for the case where the temperature of inlet fluid is kept constant. The temperature of fluid, foil, and pipe as functions of distance from inlet and time are obtained. The results of numerical calculation of four cases of

examples show good performance of thermal insulation by multi-layered metal foil. A simple expression of the solution for the initial period is also given. Author

N67-34598# Bureau of Mines, Pittsburgh, Pa.
MINIMUM IGNITION ENERGY AND QUENCHING DISTANCE IN GASEOUS MIXTURES: TECHNIQUES AND APPARATUS
E. L. Litchfield, M. H. Hay, T. A. Kubala, and J. S. Monroe
Aug. 1967 16 p refs
(BM-RI-7009)

Descriptions are given of the techniques and apparatus used by the Bureau of Mines for determinations of flat plate ignition quenching distance and minimum spark ignition energy. The descriptions include discussions of reaction vessel materials, shapes, and sizes and discussions of electrode configurations. Spherical, hemispherical, or flat plate electrodes are recommended. The preferred metal in electrodes and electrode supports is stainless steel; the flat plate electrodes incorporate flanges of low electrical conductivity which are most frequently formed from glass. Various aspects of the electrical energy supply system are discussed and suitable arrangements of components are indicated. The concept of a thermal relaxation time is introduced as a basis for the choice of a minimum interspark time during the testing of a gas mixture. The following indicate the varied conditions under which these techniques were utilized: Mixture pressures between 10 mm Hg and 45 psig, initial temperatures between −78° and +198°C, and gaseous mixtures representing wide ranges of chemical reactivity and corrosiveness. Minimum ignition energies were determined which varied from about 10^{-7} joule to nearly 10^{3} joule. Author

N67-34625*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
HANDBOOK OF OPTICAL PROPERTIES FOR THERMAL CONTROL SURFACES, VOLUME III Final Report
R. Breuch 25 Jun. 1967 81 p refs
(Contract NAS8-20353)
(NASA-CR-87484; LMSC-A847882, Vol. III) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Thermal design data and information are presented on the thermophysical properties, especially thermal radiation characteristics, of high performance insulation materials for spacecraft thermal control surfaces. The nature of the thermal control problem is reviewed and procedures of thermal design are outlined. Parameters affecting the thermal behavior of a surface are described, the effects of the spacecraft environment are discussed, and the experimental methods used to obtain design data are reviewed. Thermophysical property data on specific types of thermal control surfaces including a solar absorber, a solar reflector, a flat absorber, and a low solar absorptance surface are given. Also included is information on promising research coatings presently under investigation. R.N.A.

N67-34640# National Aerospace Lab., Tokyo (Japan).
INFRA-RED RADIATION METHOD OF DETERMINING THERMAL DIFFUSIVITY, HEAT CAPACITY AND THERMAL CONDUCTIVITY OF SOLID MATERIALS
Koichi Ogawa 1967 15 p refs In JAPANESE; ENGLISH summary
(NAL-TR-238) CFSTI: HC $3.00/MF $0.65

A new and simple method of determining thermal diffusivity, heat capacity and thermal conductivity of solid materials, and some experimental results using the method are presented. When the front surface of a plate specimen, of which the rear surface is thermally insulated, is heated by infra-red radiation lamps under uniform and constant heat flow, the rear surface temperature will be a quasi-steady state after a transient phenomenon, i.e. the temperature rises linearly with time. When heat is cut off suddenly under such a quasi-steady state, the rear surface temperature rises gradually to a constant temperature with time. These three thermal properties are determined for stainless steel, glass, bakelite, Japanese cypress and fiberglass-reinforced plastics at near 20°C. It is shown that the thermal properties of non-metallic solid materials are simply determined by this new method and that their values are easily made available for practical applications. Author

N67-34651# Lockheed Missles and Space Co., Palo Alto, Calif. Research Lab.
THERMAL RADIATION PHENOMENA. VOLUME II: THE EQUILIBRIUM RADIATIVE PROPERTIES OF AIR-THEORY
B. H. Armstrong and R. W. Nicholls May 1967 497 p refs
(LMSC-3-27-67-1, Vol. 2; DASA-1971-2; AD-654055)

Theory of radiation in hot gases (elementary radiative transfer, theory of radiation, theory of molecular absorption); spectral and mean absorption coefficients of heated air (historical review: research on hot gas absorption coefficients since 1900, general features of air absorption coefficients, molecular absorption coefficients, atomic absorption coefficients); spectroscopic properties of six important band systems which contribute to the opacity of heated air. TAB

N67-34703*# Case Inst. of Tech., Cleveland, Ohio. Dept. of Mathematics.
RADIAL TIME FUNCTIONS AND OTHER SOLUTIONS OF THE RADIAL HEAT EQUATION
Richard A. Kowalski (Ph.D. Thesis) Jun. 1967 92 p refs
(Grant NsG-544)
(NASA-CR-87809) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Expansion theorems for certain functions which are solutions of the radial heat equation, are developed. The theorems are comparable to previously developed expansion theorems in solutions of the one-dimensional heat equation. It was proved that the elements of several sets of special solutions of the radial heat equation, including the radial time functions, have a common form. L.S.

N67-34758*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF SPEECH SUPPRESSION CONCEPTS IN A 20,000-POUND-THRUST HYDROGEN–OXYGEN ROCKET
John P. Wanhainen, Ned P. Hannum, and Louis M. Russell
Washington, NASA, Aug. 1967 36 p refs
(NASA-TM-X-1435) CFSTI: HC $3.00/MF $0.65 CSCL 21B

An experimental investigation was conducted to determine the effects of (1) propellant injection radial distribution, (2) fluorine additive to the liquid oxygen, (3) extended oxidizer tubes, (4) porous injector faceplate, (5) nozzle area radial distribution, and (6) chamber wall film cooling on acoustical mode stability characteristics. Stability data were obtained at a chamber pressure of 300 pounds per square inch absolute and over a range of oxidant-fuel ratios from 3.5 to 6.5. Hydrogen injection temperature was used to rate the stability of the various designs. The combustor with the lowest self-triggering temperature was considered to be the most stable design. Concentrating the propellant injection radial distribution had a detrimental effect on longitudinal mode stability. Addition of fluorine to the oxygen to an amount of 30 percent by weight had no significant effect on stability; however, characteristic exhaust velocity efficiency was improved by 1 to 3 percentage points. The combustor stability characteristics were significantly improved by the wagon wheel nozzle, the porous faceplate, and the extended oxidizer tubes. Chamber wall film cooling produced no major change in the hydrogen temperature stable operating

limits. Performance, however, decreased 2 to 3 percentage points for each 10 percent of hydrogen flow diverted for film cooling. Author

N67-34804*# Aerojet-General Corp., Sacramento, Calif.
DESIGN EQUATION ANALYSIS FOR HEAT TRANSFER TO CRYOGENIC HYDROGEN AT PRESSURES FROM 600 TO 1500 PSIA AND WALL-TO-BULK TEMPERATURE RATIOS TO 20
Jun. 1966 65 p refs
(Contract SNP-1)
(NASA-CR-87511; RN-S-0274) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Experimental single-tube heat-transfer data from all available sources have been analyzed in terms of various design equations in an effort to select that model which best represents the data. Cryogenic hydrogen data so analyzed were restricted to the pressure range from 600 to 1500 psia and to wall-to-bulk temperature ratios to 20. A graphical presentation of the ratio of the experimental to the computed heat transfer coefficient as a function of bulk temperature was made for each design equation studied. A lower-limit line was constructed as the locus of the high-density data point concentration; the nominal design equation was then established so that the lower limit line was 80% of the nominal equation. The level of confidence for each modified equation was then based on the percentage of data points located within the ±20% limits to the nominal lines. From these plots a variable liquid-side coefficient was determined as a function of bulk temperature. Author

N67-34805# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
INVESTIGATION OF HEAT TRANSFER AND SUCTION AS A MEANS FOR TRIPPING THE BOUNDARY LAYER Final Report, 21 Apr.–21 Oct. 1966
T. Cebeci and A. M. O. Smith Oct. 1966 29 p refs
(Contract NOw-66-0396-c)
(DAC-33394; AD-653980) CFSTI: HC $3.00/MF $0.65

An experimental investigation was made to determine the feasibility of tripping the laminar boundary layer on an airfoil by means of heat transfer or suction through an isolated hole. The effect of heat transfer on both favorable and adverse pressure gradients was studied. It was found that neither heat transfer nor suction was adequate to precipitate transition within the limits of these experiments for chord Reynolds numbers between 1.6 x 1,000,000 and 2.46 x 1,000,000. The experimental findings were checked by the boundary-layer-stability analysis, and excellent agreement was obtained with experiment. Author (TAB)

N67-34877# National Aerospace Lab., Tokyo (Japan).
AN EXPERIMENTAL STUDY OF MELTING PHENOMENA IN THE AXISYMMETRIC STAGNATION REGION OF THERMALLY HIGH-CONDUCTING MATERIALS
Yasuhiko Aihara Mar. 1967 10 p refs
(NAL-TR-130T) CFSTI: HC $3.00/MF $0.65

An experimental study was conducted to investigate the periodic patterns on the surface of the molten layer in the axisymmetric stagnation regions of copper and iron cylindrical rods. Steady radial ridges and propagating waves were observed during the melting of the test pieces. These patterns were interpreted from the experimental investigation to be hydrodynamic phenomena of the molten layer. By processing the test pieces, it was concluded that the surface force is the controlling physical quantity of these molten layers. Author

N67-34944# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
THE NUMERICAL TREATMENT OF A THIN PLATE HEAT TRANSFER PROBLEM
G. W. Stewart, III and Dale W. Lick 31 May 1967 18 p refs
(Contract W-7405-ENG-26)
(K-1695) CFSTI: HC $3.00/MF $0.65

The numerical solution of a system of linear equations resulting from a discrete approximation to a thin plate heat transfer problem is reported. The slow convergence of a standard iterative method is analyzed and shown to be caused by one of the boundary conditions. A line iterative method which removes the difficulty is described. Author

N67-34955# Bureau of Mines, Amarillo, Tex.
A TWO-CONSTANT EQUATION FOR HELIUM FROM 30° TO 1,473°K
Jonnie M. Estes and Philip C. Tully Aug. 1967 18 p refs
(BM-RI-7003)

A two-constant equation is presented for helium from $30° \leq T \leq 1,473°K$. This equation is developed by modifying a generalized equation of state originally presented by Redlich and Kwong. The modification consists of setting $B = 0.06372\ T_c/P_cT$. This modified equation represents the compressibility factors of each of 80 isotherms tested in this temperature range to less than 1 percent average deviation. Author

N67-34982*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
HIGH-PERFORMANCE "ONCE-THROUGH" BOILING OF POTASSIUM IN SINGLE TUBES AT SATURATION TEMPERATURES OF 1500° TO 1750°F
J. R. Peterson Washington, NASA, Aug. 1967 188 p refs
(Contract NAS3-2528)
(NASA-CR-842) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The results of boiling potassium experiments conducted with a sodium-heated Haynes-25 alloy test facility at temperatures to 1750°F are presented. The results include data and correlations for the critical heat flux, transition boiling heat transfer coefficient and boiling pressure loss, as well as a few values of the superheated vapor heat transfer coefficient. Potassium heat transfer coefficients averaged over the entire length in boiling are also presented. The data are applied to the design of a large power boiler, which is analyzed with respect to uncertainties in the design variables. Author

N67-34985 Osterreichische Studiengesellschaft fur Atomenergie G.m.b.H., Seibersdorf (Austria). Institut fuer Reaktortechnik.
CONTROL THEORY FOR HEAT EXCHANGER CONSISTING OF TWO CONCENTRIC TUBES IN ONE-DIMENSIONAL REPRESENTATION [DAS REGELTECHNISCHE VERHALTEN DES WAERMETAUSCHERS AUS ZWEI KONZENTRISCHEN ROHREN IN EINDIMENSIONALER DARSTELLUNG]
H. Eigner [1966] 18 p refs In GERMAN
(SGAE-RT-11/1967)

Theoretical and experimental studies were made to determine the behavior of heat exchangers in terms of control theory and to improve existing theoretical models. The heat exchanger model used in the experiments is described by the usual approximation theory, and the first extreme values of the transfer function of primary input and secondary output in counterflow operation were calculated on a digital computer. A system of equations is derived from the energy balance for a standard length of the heat exchanger. The extreme values for amplitude and phase of the equations for the frequency response characteristics are calculated, and the stability of the equations is discussed. Transl. by K.W.

N67-34996*# Republic Aviation Corp., Farmingdale, N. Y.
A SUPERSONIC COMBUSTION TEST PROGRAM UTILIZING GAS SAMPLING, OPTICAL AND PHOTOGRAPHIC MEASURING TECHNIQUES Final Report
Anthony Casaccio and Richard L. Rupp [1967] 115 p refs
(Contract NAS1-6314)
(NASA-CR-66393) CSCL 21B

Effects of certain parametric variations on the supersonic combustion of hydrogen in air were investigated. The test program was performed in a one-megawatt arc-jet facility at a Mach number of 2.35 and an air static pressure of 0.5 atm. Free-jet testing of single, three-point and peripheral (ring) injection geometries were conducted for controlled variations in air static temperature, fuel total temperature, fuel-to-air velocity ratio, fuel-air equivalence ratio and fuel–air spacing. Two segmented combustor contours were also tested for various air static temperatures (2100°R, 2700°R, 2900°R and 3100°R), fuel stagnation temperatures of 600°R and 1000°R and fuel–air equivalence ratios of 0.5 and 1.0. Spectroscopic and photographic techniques were employed to measure combustion stream temperatures and to note general flame characteristics. Gas samples were extracted from the combustion stream for each of the test runs and analyzed in a gas chromatograph. Wall pressures and temperatures were recorded for each of the segmented combustor test runs in the series. Results show that changes in air static temperature, equivalence ratio and fuel–air velocity ratio have, in general, a more pronounced effect on combustion characteristics than changes in fuel stagnation temperatures. Slight effects due to variation in fuel–air spacing were also noted. Author

N67-35009*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
THERMAL AND HYDRAULIC PERFORMANCE OF POTASSIUM DURING CONDENSATION INSIDE SINGLE TUBES
S. G. Sawochka Washington, NASA, Aug. 1967 164 p refs
(Contract NAS3-2528)
(NASA-CR-851) CFSTI: HC$3.00/MF$0.65 CSCL 20M

Forced convection heat transfer and pressure change data for condensation of potassium in vertical downflow inside single tubes are presented. These data, obtained at saturation temperatures from 1100°F to 1400°F, inlet vapor Mach numbers from about 0.1 to near 1.0 and local heat fluxes up to 300,000 Btu/hr-ft^2 provide a reasonable basis for thermal design of forced convection potassium condensers applicable to space power systems. Author

N67-35022# Entwicklungsring Nord, Bremen (West Germany).
THE DETERMINATION OF THE THERMAL CONDUCTIVITY OF THE SPECIFIC HEAT AND THE DENSITY (GROSS DENSITY) OF INSULANTS FOR ROCKET TANKS FILLED WITH LIQUID HYDROGEN. PART 1: DESCRIPTION OF MEASURING METHOD [DIE BESTIMMUNG DER WAERMELEITFAEHIGKEIT DER SPEZIFISCHEN WAERME UND DES RAUMGEWICHTS (ROHDICHTE) VON ISOLATIONEN FUER MIT FLUESSIGEM WASSERSTOFF GEFUELLTE RAKETENTANKS. TEIL 1: BESCHREIBUNG DER MESSVERFAHREN]
B. Koglin and W. F. Zimni *In* European Space Vehicle Launcher Develop. Organ. ELDO Tech. Rev., Vol. 2, No. 1 1967 26 p refs In GERMAN; ENGLISH summary (See N67-35021 20-31)

In addition to a brief general study of the insulation of tank walls for cryogenic high-energy rocket stages, the description and discussion of various measuring methods for determining thermal conductivity, specific heat, and density in insulating materials, together with a comprehensive review of the literature are given. Author (ESRO)

N67-35032 Maschinenfabrik Augsburg-Nurnberg A. G., Nuremberg (West Germany).
INVESTIGATIONS INTO THE CRITICAL HEAT FLUX IN BOILING Final Report
F. Mayinger, O. Schad, and E. Weiss May 1966 364 p refs
(Contract EURATOM-057-61 RDD)
(Rept.-09-03-01)

The measurement of the critical heat flux (burnout) in boiling, the effects of the history and the inlet conditions as well as the L/D ratio of the test channel on nucleate boiling, and the inception of film boiling were investigated. The tests were made at pressures of 70 to 140 kgf/cm^2 using internally cooled tubes with diameters varying from 0.7 to 1.5 cm. The conditions at the test channel inlets covered mass flows between 100 and 350 g/cm^{2}s between a degree of sub-cooling of 20% and 20% steam quality. Two types of burnout were observed which are completely different in their physical appearance. One type is characterized by the occurrence of fluctuations in the pressure and mass flow shortly before film boiling starts and was designated "pulsating burnout". The other type shows a hydrodynamically completely stable behavior until film boiling suddenly occurs. Pulsating burnout which was observed only in the range of sub-cooled boiling was found to lead to critical heat flux levels 20 to 50% below those obtained with hydrodynamically stable flow. Author

N67-35065# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugzeugbau.
MEASUREMENT OF THE COEFFICIENT OF THERMAL CONDUCTIVITY OF FELT-LIKE INSULATING MATERIAL [MESSUNG DER WAERMELEITZAHL FILZARTIGER ISOLIERSTOFFE]
C. B. v. Stieglitz Mar. 1967 27 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-29) CFSTI: HC$3.00/MF$0.65

The thermal conductivity of carbon felt was measured from 139°C to 314°C. A test device was developed producing an axialsymmetric steady temperature distribution in the test specimen. The thermal conductivity was determined to 0.049 kcal/mh deg at 139°C and to 0.076 kcal/mh deg at 314°C. Author

N67-35080 Joint Publications Research Service, Washington, D. C.
STUDY OF PHASE AND DIFFUSION RESISTANCE DURING CONDENSATION OF ALKALI METALS
N. V. Bakulin, M. N. Ivanovskiy, V. P. Sorokin, V. I. Subbotin, and B. A. Chulkov *In its* Probl. of High-Temp. Reactor Operation 31 Jul. 1967 p 51–57 refs (See N67-35075 20-22)

The thermal resistance during surface condensation of metallic vapors is composed of the resistance of the condensate layer and of the boundary resistances: that due to the phase connected with the temperature jump at the vapor–liquid phase boundary and the one due to diffusion caused by the presence of vapor admixtures, joined with the contact resistance if there exists low heat conducting contaminations at the condensate-wall boundaries. One finds heat transfer coefficients during the condensation of alkali metals. These coefficients are for all practical purposes fully determined by the boundary resistances that lead to such a reduction of transfer coefficients. To investigate these questions we carried out experiments with three alkali metals: potassium, sodium, and lithium. Author

N67-35196 Osterreichische Studiengesellschaft fur Atomenergie G.m.b.H., Seibersdorf (Austria). Institut fuer Reaktortechnik.
THE CONDUCTING FUNCTION OF HEAT EXCHANGERS: A COMPARISON OF WELL-KNOWN METHODS OF ANALYSIS WITH EXPERIMENTAL RESEARCH [DIE UEBERTRAGUNGSFUNKTION DES WAERMEAUSTAUSCHERS: EIN VERGLEICH DER BEKANNTEN BERECHNUNGSMETHODEN MIT EXPERIMENTELLEN UNTERSUCHUNGEN]
H. Schmidl May 1967 31 p refs In GERMAN
(SGAE-RT-12/1967)

The vaporless heat exchange from water to water was studied experimentally for a reactor heat exchanger and theoretically by calculating the heat transfer functions for a lumped parameter model. Observed were water temperatures and flow velocities by oscillograph for a heat exchange element consisting of two concentric tubes; periodic disturbances of varying frequencies at the primary entrance of the heat exchanger provided secondary temperature oscillations. Comparison between measured and theoretically obtained values showed pronounced differences; at higher frequencies, primary deviations from experimental results were large. Transl. by G.G.

N67-35211# Weapons Research Establishment, Salisbury (Australia).
HEAT CONDUCTION IN HEMISPHERICAL SHELLS WITH APPLICATIONS TO AERODYNAMIC HEATING
L.C. Heron Apr. 1967 44 p refs
(HSA-124) CFSTI: HC $3.00/MF $0.65

A solution to the problem of heat conduction in hemispherical shells insulated at the inner surface is presented. Two successive integral transforms are used to obtain the solution. The results have been extended to include aerodynamic heat transfer to the outer surface and are applicable when the inner radius to thickness ratio is 8 or greater. Examples for thermally thin and thermally thick shells are given. In the former case a simplified solution is derived. Author

N67-35279# European Atomic Energy Community, Ispra (Italy).
VOID FRACTION MEASUREMENTS IN A TWO-PHASE FLOW NaK/ARGON [MESURE DE LA FRACTION DE VIDE DANS UN ECOULEMENT DOUBLE PHASE NaK-ARGON]
B. Milliot, J. Lazarus, and J.-Ph. Navarre Jun. 1967 68 p refs In ITALIAN; ENGLISH summary
(EUR-3486.f) CFSTI: HC $3.00/MF $0.65

Several measuring methods have been proved and calibrated for determining the void fraction in vertical two-phase flow of NaK. The emulsion was created by injecting Argon in the liquid metal. Results have been obtained in bubble flow using EM flowmeters, changes in electrical resistance, γ-rays attenuation, and two-phase pressure drop. All results are compared with each other and checked with the theoretical model of Marchaterre and Hoglund. As to the slip ratio some difference has been observed. Moreover all results have been plotted in the Lockhart–Martinelli diagram. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N67-34156*# Massachusetts Inst. of Tech., Cambridge. Alfred P. Sloan School of Management.
THE ROLE OF FOLLOW-ON CONTRACTS IN GOVERNMENT-SPONSORED RESEARCH AND DEVELOPMENT
Edward B. Roberts and William H. Dyer, III Jul. 1967 31 p refs
(Grant NsG-235)
(NASA-CR-87404; Rept.-289-67) CFSTI: HC $3.00/MF $0.65
CSCL 05A

Eighteen new business research and development (R&D) contracts were studied to determine the effects of considerations of follow-on potential on contract performance and to determine the impact of these factors on further contract acquisition. The three dimensions of contract performance (schedule, cost, and technical) correlated significantly with each other, and problems in each area correlated with the growth in contract costs. These contract problems were greatest in those cases where greatest potential R&D and production follow-on was expected at the time of original proposal preparation. This suggests that companies that anticipated large follow-ons wrote into their initial R&D proposals promises of unrealistic time schedules, cost estimates and technical performance goals. The general likelihood of R&D follow-ons was more accurately predictable at the time of original proposal preparation than is the likelihood of production follow-ons. However, except for the trivial cases in which it was clear that no follow-on potential exists, defense/space marketing men appeared unable to predict effectively the dollar magnitude of the resulting follow-on contracts. The greater the problems encountered during contract life, the less the original expectation of direct follow-on from the same government agency was realized. However, this was counterbalanced by a marked improvement in win ratio in technically related competitions conducted by other government agencies. Author

N67-34202*# Massachusetts Inst. of Tech., Cambridge.
MOTIVATION OF R AND D ENTREPRENEURS: DETERMINANTS OF COMPANY SUCCESS
Herbert A. Wainer and Irwin M. Rubin Jan. 1967 20 p refs
(Grants NsG-235; NsG-496)
(NASA-CR-87442; Rept.-234-67) CFSTI: HC $3.00/MF $0.65
CSCL 05J

The relationships between the entrepreneurs' need for achievement, need for power, and need for affiliation were related to the performance of the eighteen small companies they founded and operated. The results indicate that the entrepreneurs' need for affiliation is not a significant factor in determining company performance. However, high need for achievement and moderate need for power are associated with high company performance. High need for achievement seems to be a necessary condition for high performance whereas moderate need for power seems to make it more probable. The influence of need for power on performance seems to be derived through its determination of leadership styles. High need for power appears to be indicative of an authoritarian and low need for power indicative of a laissez-faire style of leadership. On the other hand moderate need for power seems to be indicative of a democratic style of leadership. Author

N67-34255 Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA: SCIENCE AND TECHNOLOGY, NO. 379
25 May 1967 31 p refs Transl. into ENGLISH from Chinese
(JPRS-41156; TT-67-31797) CFSTI: $3.00

CONTENTS:

1. THE TECHNICAL PERFORMANCE OF NON-PULSE RADAR SYSTEM (PART I & II) T. Wang-p'ing p 1–25 refs (See N67-34256 20-07)

2. THE NEW CITY OF SAN-MEN-HSIA Ku Feng-nien p 26–28

N67-34449# National Science Foundation, Washington, D. C.

THE PROSPECTIVE MANPOWER SITUATION FOR SCIENCE AND ENGINEERING STAFF IN UNIVERSITIES AND COLLEGES, 1965–75

Thomas J. Mills et al May 1967 33 p refs

(NSF-67-11) GPO: $0.30

Teaching and research are the principal activities of higher education and will largely determine staff needs between 1965 and 1975. Employment of science and engineering staff is expected to approximately double as a result of needs arising from expanding enrollments and research. In addition to recruitments to fill these needs, universities and colleges will have to replace normal attrition. The requirements for doctorates in these fields will greatly exceed the probable supply available to universities and colleges in the early part of the period. By the early 1970's the growing numbers of doctorates will approximate the academic requirements, and the situation will improve. However, the proportion of science staff holding the doctorate degree will decline for several years after 1965 and, even at the end of the decade, will not be as high as the 1965 ratio. Author

N67-34460*# Columbia Univ., New York. Operations Research Group.

OPTIMAL CONTINUOUS REVIEW POLICIES FOR TWO PRODUCT INVENTORY SYSTEMS WITH JOINT SETUP COSTS

Edward Ignall 15 Dec. 1966 13 p refs

(Contract Nonr-266(55))

(NASA-CR-87490; TR-35; AD-650793) CFSTI: HC $3.00/MF $0.65 CSCL 05A

Minimum average cost ordering policies for continuously reviewed two product inventory systems with joint setup costs are sought. Disappointingly, the optimal policy, even in a simple symmetric case, is not always simple: For some values of cost and demand parameters, a policy that would be difficult to implement is optimal. Markov Renewal Programming is used to find the region in parameter space where a given policy is optimal. TAB

N67-34479# Army Materials Research Agency, Watertown, Mass.

PAPER 7—THE USE OF INDUSTRY DOCUMENTS BY THE GOVERNMENT

T. E. Dunn, Jr. *In its* Defense Conf. on Nondestructive Testing 1966 p 129–131 (See N67-34467 20-15)

Brief conference remarks are presented on permissive use of industry documents by the Government in accordance with the Armed Services Procurement Regulators. Coverage of a commodity or test method by an industrial society specification or standard was duplicated by the Government or vice versa, and did not tend to standardization. Two projects are cited of efforts made to combine the two coverage methods. R.U.

N67-34500# National Science Foundation, Washington, D. C.

NATIONAL PATTERNS OF R AND D RESOURCES. FUNDS AND MANPOWER IN THE UNITED STATES, 1953–1968

Olive Q. Baker Apr. 1967 32 p refs

(NSF-67-7) GPO: $0.30

An overview is given of trends in expenditures and employment in research and development from 1953 to the present, along with estimates for 1968. Data are based on recurring surveys covering current operating expenditures for virtually all the basic research, applied research, and development carried on by universities and colleges, industry, Federal Government agencies, and independent nonprofit organizations. Presented are revised and update time series on operating expenditures for research and development (1965–68) and basic research (1953–66) in current dollars through 1965, updated and revised statistics on the employment of R and D scientists and engineers (1956–65), and transfer tables for R and D and basic research expenditures (1966). Intersectoral relationships underlying R and D financing are also identified. E.C.

N67-34518# California Univ., Berkeley. Operations Research Center.

NATURAL GAS TRANSMISSION SYSTEM OPTIMIZATION: A MATHEMATICAL PROGRAMMING MODEL

Arnoldo Hax May 1967 154 p refs

(Grant NSF GP-4593)

(ORC-67-19)

A natural gas transmission system transports gas from sources of supply to remote locations where there is a varying demand for the gas for residential, commercial and industrial uses. A system consists of sources of gas, demands for gas, storage facilities and compressor stations all connected by pipelines. A mathematical model that represents, with enough accuracy, the operations of a real system is formulated. The objective of the model is the maximization of the net profit of running the system by specifying in an optimal manner how gas purchases, sales, and storage over time, together with the way in which the compressor stations should be operated. Since the time intervals at which decisions are made are taken sufficiently small, we have to deal with transient conditions. The solution of the model presents three types of difficulties: (1) The compressor introduces nonlinearities both in the constraints and in the objective function; (2) The objective function is not concave and the constraint set is nonconvex; (3) Any real system gives rise to a large scale problem, which makes the use of linear programming highly desirable. A two-stage parametric linear programming method is presented in which the nonlinearities are handled by solving a sequence of linear programs parameterized on the values of the compression ratios. Both the convergence of the method and the ways of solving large scale systems are analyzed. Several encouraging computational results are presented. Author

N67-34661# TRW Systems, Redondo Beach, Calif.

ON THE MANAGEMENT OF SPACE PROJECTS

P. J. de Fries [1967] 15 p Presented at the Symp. on Advanced Systems Techs. of the Deut. Ges. fuer Raketentechnik und Raumfahrt, Munich, 9 Jun. 1967

The organization and methodology of managing space projects are discussed. Two steps are outlined: defining the job at hand, and organizing for implementation and management control. Concerning the first, the concept of phased program planning is introduced. It includes an initial study phase which clarifies the feasibility of the mission, the concepts, and the basic design approach. This is followed with a project definition phase for detailed analysis of all end items and functions necessary for the jobs. When these phases are completed a decision is made for developing the project. The second step discussed is concerned with determining how to merge the structuring of the end items and the structuring of the functions into an organization of people with clear cut responsibilities for the end item; and how to tie the project organization into the line organization of the government agency or industrial company involved. R.N.A.

N67-34722*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RESEARCH AND DEVELOPMENT PROCUREMENTS: MARKETING PRACTICES AND PROBLEMS

Leonard Rawicz Aug. 1966 29 p Presented at the 2d GSFC-Ind. Seminar, Greenbelt, Md., 10 Aug. 1966

(NASA-TM-X-60213) CFSTI: HC $3.00/MF $0.65 CSCL 05A

In view of the need for a series of informal meetings between GSFC and industry to permit a free exchange of views on how NASA/GSFC procurement practices appear to industry, and how the general industry/Government relationship might be improved, a seminar program was established. Reviewed are discussions by panelists attending a second session of the seminar program which was entitled Becoming Acquainted with GSFC Requirements. The session was attended by three industry spokesmen representing major GSFC contractors and seven staff and line officials of GSFC. General discussions of the session were industry's marketing techniques relating to Government procurement of aerospace research and development; the Government's techniques to broaden the base of competition for contracts; and associated problems related to the source list system, government-industry briefings, and proposal timing and preparation. Specific topics discussed at this session are included in an appendix. Included are suggestions for improving competition for Government procurement. S.C.W.

N67-34727*# National Aeronautics and Space Administration, Washington, D. C.

NASA SPECIFICATIONS AND STANDARDS

May 1967 388 p refs

(NASA-SP-9000) CFSTI: HC $3.00/MF $0.65 CSCL 05B

Reported is the first edition of NASA Specifications and Standards which is an effort to assemble in one publication an up-to-date listing of specifications and standards originated by NASA, its Centers and the Jet Propulsion Laboratory through December 1966. The publication is intended to help determine what specifications and standards have been generated, where they were developed, and the organizational component responsible. It is arranged in the following three sections: Section I which is a listing of specifications and standards, displayed by the alpha-numeric designations assigned by the originating organizations; Section II which is a subject index; and Section III which is an originator index. S.C.W.

N67-34918# Kernforschungszentrum, Karlsruhe (West Germany).

STUDY GROUP FOR SYSTEM DEVELOPMENT [STUDIENGRUPPE FUER SYSTEMFORSCHUNG]

Mar. 1967 52 p refs In GERMAN

(Rept.-83) CFSTI: HC $3.00/MF $0.65

Progress during 1966 is reported in research projects covering the following fields or subjects: (1) management planning and theory in scientific research and education; (2) research and development studies in economics; (3) application of mathematical models and graph theory in planning; (4) systems analysis and documentation methods in scientific research, particularly in organic chemistry; (5) work and pay studies in research; and (6) sociological and organization problems in research institutions. Transl. by K.W.

N67-35072*# Connecticut Univ., Storrs. New England Research Application Center.

[ESTABLISH AND OPERATE A REGIONAL DISSEMINATION CENTER] Quarterly Progress Report, 1 Apr.–1 Jul. 1967

1967 29 p refs

(Contract NSR-07-002-029)

(NASA-CR-87505) CSCL 05B

This document reports the progress made to establish and operate a regional dissemination center under the auspices of the Technology Utilization Program. The first three months have seen our efforts primarily devoted to becoming operational. The recruitment of staff, the acquisition of data, documents and equipment, and the movement into larger quarters all have taken place. The current estimate of achieving full operational status is July 10. Marketing efforts have been delayed until essentially immediate service would be possible. Case documentation activities have gotten under way in order to establish an initial point of reference. Work for a management workshop in technology transfer and utilization has begun as has work on proposals to the State Technical Services groups in Connecticut and Massachusetts. Author

N67-35081# Israel Program for Scientific Translations, Ltd., Jerusalem.

HYGIENE EFFECTS AND CONTROL OF DUSTS, FOGS, GASES, VAPORS, RADIOACTIVE PARTICLES

H. Schneider, ed. 1966 58 p refs Transl. into ENGLISH from VDI (Ver. Deut. Ingr.) Z. (Dusseldorf), v. 26, no. 9, Sep. 1966

CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. RESULTS OF COMPARATIVE DUST MEASUREMENTS WITH INSTRUMENTS WHOSE SAMPLES ARE EVALUATED EITHER GRAVIMETRICALLY OR NUMERICALLY M. Landwehr p 1–15 (See N67-35082 20-34)

2. THE SIMULTANEOUS DETERMINATION OF LEAD CONTENT IN THE AIR OF A WORKING PLACE BY FOUR LABORATORIES R. Mappes p 15–18 (See N67-35083 20-11)

3. COMPARATIVE STUDY OF METHODS FOR DETERMINATION OF PARTICLE SIZE J. Simecek p 18–26 refs (See N67-35084 20-14)

4. THE MEASUREMENT OF HYDROGEN SULFIDE IN THE ATMOSPHERE M. Buck and H. Gies p 27–33 refs (See N67-35085 20-06)

5. ODOR THRESHOLDS OF SOLVENTS FOR ASSESSMENT OF SOLVENT ODORS IN THE AIR J. May p 34–38 refs (See N67-35086 20-06)

6. SOME REMARKS ON COMPARATIVE DUST PRECIPITATION MEASUREMENTS H. Nagel p 39–40 refs (See N67-35087 20-14)

7. MINIMUM STACK HEIGHTS AND AREA AROUND STACK WITHIN WHICH BUILDINGS MUST BE CONSIDERED K. Graefe and J. Hagen p 41–43 refs (See N67-35088 20-34)

N67-35082# Israel Program for Scientific Translations, Ltd., Jerusalem.

RESULTS OF COMPARATIVE DUST MEASUREMENTS WITH INSTRUMENTS WHOSE SAMPLES ARE EVALUATED EITHER GRAVIMETRICALLY OR NUMERICALLY

Martin Landwehr *In its* Hyg. Effects and Control of Dusts, Fogs, Gases, Vapors, Radioact. Particles 1966 p 1–15 (See N67-35081 20-34)

Comparative dust measurements, carried out on an international level, in which thermal precipitators, konimeters and dust collecting devices with millipore filters were used, as well as instruments with samples evaluated gravimetrically, are presented. In addition, the tyndalloscope and the aerosol spectrometer by Timbrell were employed. The measurements show that the various instrument designs generally differ from one another, as regards structure and mode of operation, to such an extent that a direct comparison of results is impossible. The disparities between measuring results can frequently be explained by the fact that the evaluation was carried out according to different points of view. An attempt must, therefore, be made to bring the different countries to an agreement with regard to the method of assessing dust conditions given by test results. Author

N67-35088# Israel Program for Scientific Translations, Ltd., Jerusalem.
MINIMUM STACK HEIGHTS AND AREA AROUND STACK WITHIN WHICH BUILDINGS MUST BE CONSIDERED
Kurt Graefe and Joachim Hagen *In its* Hyg. Effects and Control of Dusts, Fogs, Gases, Vapors, Radioact. Particles 1966 p 41–43 refs (See N67-35081 20-34)

In order to calculate the distance from the stack covering the area where buildings have to be considered, a formula is derived from the equation for the distribution of the SO_2 concentration in the surroundings of a source. Thus a suggestion is made with regard to an addition to previously published rules for minimum stack heights. An example illustrates the possibilities of practical applications. Author

N67-35141# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 386
13 Jul. 1967 47 p refs Transl. into ENGLISH from Chinese (JPRS-41810; TT-67-32442) CFSTI: $3.00

CONTENTS:

1. A CURSORY SURVEY OF ROCKET DEVELOPMENT IN COMMUNIST CHINA J.-s. Huang p 2–13 refs (See N67-35142 20-31)

2. COMMUNIST CHINA'S NUCLEAR BASE AT LANCHOW I.-h. Chin and J.-s. Huang p 14–32 refs (See N67-35143 20-11)

N67-35238*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
COMPATIBILITY OF COORDINATE INDEXING OF BOOKS WITH TECHNICAL REPORT LITERATURE FOR THE NASA MSC MECHANIZED RETRIEVAL SYSTEM
Martin P. Mc Donough and Geoffrey J. Roth Apr. 1967 68 p (NASA-TM-X-60154; MSC-BM-MR-67-1) CFSTI: HC $3.00 CSCL 05B

Several hundred technical books and monographs were catalogued and indexed in a test program to determine the feasibility of effectively indexing these documents using coordinated indexing techniques. Other objectives included determining the relative compatibility of book and monograph indexing with reports indexing, and assessing the effectiveness of information retrieval operations on the test documents. The test sample was indexed at the chapter level. Resulting coordinate descriptors were entered on standard forms and processed onto punched cards for input into a Univac 1108 computer. Indexing operations in general are thoroughly reviewed with emphasis given to indexer background, training, and working environment. Study data are included on indexing procedures followed, average indexer output, total descriptors used, processing time, indirect cost estimates, and problems encountered, particularly during computer operations. E.C.

N67-35246 Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA: SCIENCE AND TECHNOLOGY, NO. 384
30 Jun. 1967 45 p
(JPRS-41649; TT-67-32282) CFSTI: $3.00

CONTENTS:

1. REGULATIONS CONCERNING VARIOUS STANDARD CODES p 1–4

2. THE DRESSING QUALITY OF IRON ORES IN CHINA Tsai Huai-chih p 5–23

3. STUDY ON CHINESE COMMUNIST CAPABILITY FOR STRATEGIC EMPLOYMENT OF NUCLEAR MISSILES I. Sosi p 24–32 (See N67-35247 20-34)

N67-35247 Joint Publications Research Service, Washington, D. C.
STUDY ON CHINESE COMMUNIST CAPABILITY FOR STRATEGIC EMPLOYMENT OF NUCLEAR MISSILES
Itatsue Sosi *In its* Transl. on Communist China: Sci. and Technol., No. 384 30 Jun. 1967 p 24–32 Transl. into ENGLISH from Zaisei Sunju Sha (Tokyo), 1966 p 1–12 (See N67-35246 20-34)

Communist China's recent progress in developing nuclear warheads and weapons is examined. Raw nuclear materials, mining and refining plants, and atomic research facilities in China are discussed. Key scientific personnel are mentioned. Information on missile development is also presented, and experimental problems of missile testing are discussed. The outlook for the future (by the author) indicates that the rate of perfecting a nuclear missile strategic system in Red China may be faster than predicted by some authorities, but that it is unlikely that Red China will complete such a system before 1970. In contrast, the completion of a defense system for the purpose of hitting the neighboring targets of U.S. bases can be made within the next two or three years. L.S.

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